EDITORIAL

THE revelation that both R.C.A. in America and E.M.I. in England have perfected methods of modulating stereo programs on standard A.M. radio stations is of the greatest interest.

So far there has been quite a bit of activity in the broadcasting world, overseas and in Australia, too, with the broadcasting of stereo. In Australia the two channels are provided by pairs of broadcasting stations, one stereo channel being radiated by each.

This is effective, but in the long run it is uneconomical for the broadcasting stations and awkward for the listener.

In America, quite a few dual AM/FM operators use their two stations for stereo. Naturally this requires two receivers of different types, and two transmitters, the modulation characteristics of which are not the same.

But by using a double-sideband type of transmission most of the immediate difficulties appear to have been solved. There is no disturbance to the AM station and its place in the broadcast band. It need occupy no significantly altered bandwidth.

A receiver which can separate the two sidebands and thus extract the stereo effect will obviously be more complicated and costly than the normal type, but how much more is not yet clear. The standard receiver will not know the station is being used for stereo, for it will receive both sidebands as before. Thus the system will be quite compatible.

There is no doubt about the future of stereo in the world of reproduced sound, any more than there is about the need for broadcasting to capitalise on every possible means to render itself more attractive.

Previously it appeared as though stereo broadcasting would have to wait for FM and its promise of multiplex systems. Now it seems possible that there is new life for stereo and the AM bands. It may even be that stereo on AM could delay the introduction of FM for many years, if it works as well as it sounds.

One thing is certain — many people are going to be vitally concerned if it does.

John Moyle

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RADIO ★★ TELEVISION AND HOBBIES

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OUR COVER PICTURE

Within the next few months, the Boeing 707 will be a familiar sight at Australia's International airports, carrying the emblem of Qantas. It can carry up to 120 passengers at speeds between 500 and 600 m.p.h. (See story, page 9).

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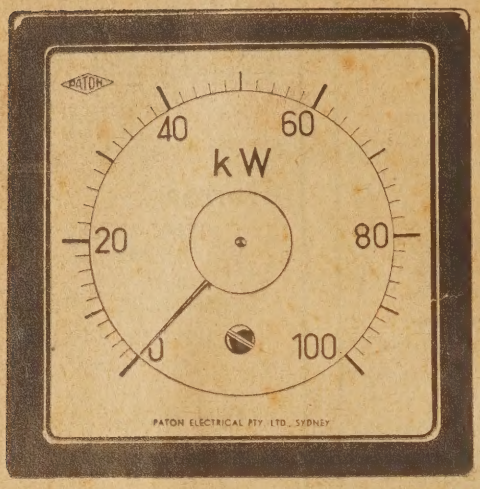

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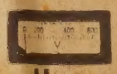
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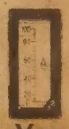
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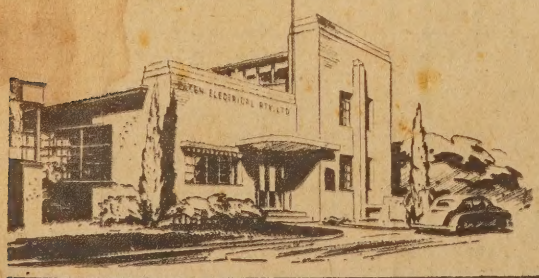

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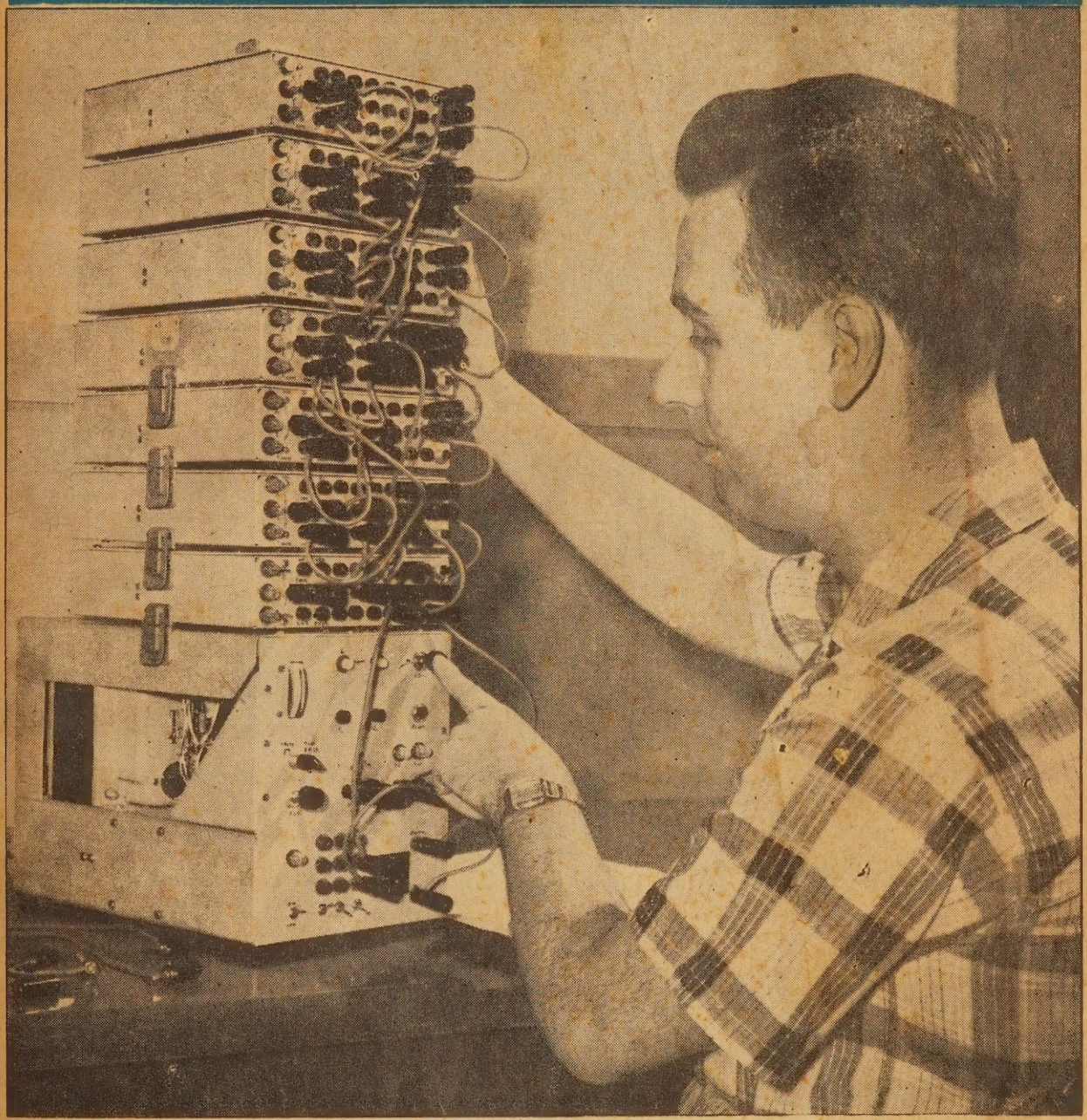
DEVICE AIDS COMPUTER DESIGN



CONSIDERABLE savings in the cost of developing electronic computer circuits are now possible through use of this new digital computer circuit simulator developed by the Sand Research Institute, California, U.S.

The new device eliminates in many instances the need for large and complex test or pilot models of computer circuits and related components. Building these models is expensive and time-consuming. In addition, they are usually limited to a one-time use and are not flexible enough for application to other computer circuitry problems.

With the simulator, called the "basic universal relay programmer," a wide variety of digital networks can be set up economically under conditions particularly suitable and convenient for detailed study. Just one wiring configuration, for example, can be used to simulate over 1,000 circuit conditions. Billions of other configurations can be similarly set up to obtain different results.

The major components of the programmer are several electronic memory units that function as basic digital computer circuit elements. Each unit includes a plug-board which permits rapid and easy "plug-in" interconnection or disconnection with "patch-cords," similar to those used on telephone switchboards. Timing and counting are provided to expedite the testing and running through of calculation sequences without constant attention. The programmer is compact, easily handled, and relatively inexpensive to construct.

The memory units can also be connected to function as a small calculator. This particular capacity has been especially useful in the solution of unconventional mathematical problems that have arisen in the development of systematic design techniques for digital computers

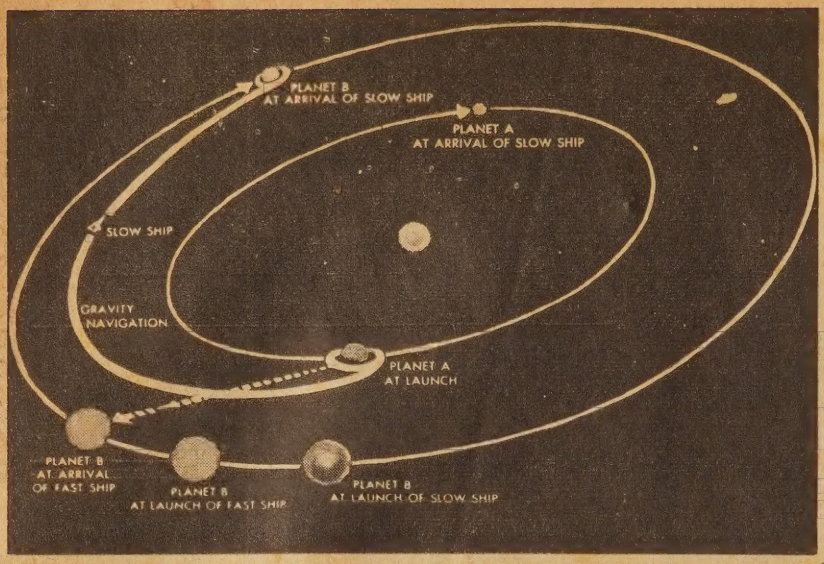


Fig. 1. Drawing shows difference between slow and fast-ship navigation.

How We Will Steer In Outer Space

In his position of Advisory Engineer for Missile Guidance and Space Communications of Westinghouse, the author has probed deeply into questions of how ships can navigate through space. These are still the major problems facing pioneers of space travel.

By Dr. PETER A. CASTRUCCIO
Westinghous Advisory Engineer

MAN will conquer space. He will travel to the moon, and to other planets in our solar system.

But if he is to succeed in this most dramatic of all human undertakings, he must first solve two great problems. I believe we can reasonably expect solutions to both.

The first of these problems, of course, is to develop power plants powerful enough to push him out into the vastness of space and return him to earth. Travel in space itself requires relatively little power; most of the energy must be spent in overcoming gravitational pull of the earth, and of the moon or other bodies which man has the daring to explore. The initial push requires so much power that today's power plants are barely equal to the task. Not much power is left available for actual space travel.

For this reason we must use to the utmost any natural forces which are available — and fortunately, powerful sources are available. We can take advantage of these forces in a method known as "gravity navigation."

Imagine, for a moment, that there is a spaceship travelling around the sun at the same speed as the earth travels around the sun. Two forces act on this ship: The pull of the sun and the centrifugal force of the ship's motion. These forces are exactly equal; the ship neither falls toward the sun nor escapes outward. Now imagine that we add a gentle push in the same direction the ship is travelling. The ship speeds up, its centrifugal force increases, and exceeds the inward pull of the sun. This causes the orbit of the ship to become elongated. The ship now follows an ellipse or oval route through space. The secret of gravity navigation lies simply in making the furthest point of the ellipse coincide with the planet we wish to reach.

GRAVITY NAVIGATION

Without question we can and will use this system of gravity navigation in the near future. We'll make the trip in two steps. First, the ship will vanquish the pull of the earth by acquiring sufficient speed (some 18,000 miles per hour) to orbit around the earth. As an earth satellite, of course, it will be moving, with the same speed as the earth, around the sun. Next we'll give it a relatively gentle push at precisely the right instant and in precisely the right direction to send it out on an elliptical orbit around the sun. If the push is exactly right, it will carry the ship to one of the planets, which also is orbiting around the sun. Thus we can use the speed of the earth as a "springboard to space."

Obviously this method is time consuming. The speed of travel is limited, and we must wait possibly months or years for the planets to assume their proper positions for such a voyage. We are in much the same situation as the ancient sailing master, who had to await favourable tides and whose speed was limited by the strength of the wind in the sails.

But as power plants become more powerful, space travel will gradually become faster. Eventually gravity navigation will yield to straight-line powered navigation, as shown in Figure 1.

GUIDING THE SHIP

This is the sequence I see in the immediate future, initially with unmanned ships: Orbiting satellites, lunar crash-landings, round trips around the moon, landings on the moon's surface and finally interplanetary missions. Subsequently, but somewhat overlapping this evolution of unmanned space flight, will be travel by man himself in much the same sequence.

The second of the two great problems to be solved (the first was the development of power plants) is the problem of guiding a spaceship to its destination. Because we'll expend most of the ship's energy for the trip, little will remain to correct the guidance of the craft. Thus the initial "aim" of the craft must be extremely accurate; the more precise the guidance, the less fuel we'll waste.

Let's look at the guidance problem for a moment. Guidance depends upon navigation, which is simply the art of going from point A to point B. On the earth's surface, both A and B (for example, New York and Chicago) are determined by two things: Latitude and longitude.

When you navigate on earth, you simply determine the latitude and longitude of your vehicle (be it plane, ship or even car), and you can easily calculate the direction you must travel to arrive at the longitude and latitude of your point of destination. You can even become temporarily lost and still reach your destination, because A and B do not move with respect to each other.

Not so in space. Both A and B move because all planetary bodies move with respect to each other. Therefore your destination doesn't stand still. It's as though you were on a motor trip to Chicago, and Chicago kept moving all the time you were on the road.

In addition to this difficulty of a moving destination, travel in space occurs in three dimensions instead of the two (latitude and longitude) of your travel on earth. Actually, we can say that navigation in space is four-dimensional: Three space dimensions and one time dimension.

Because the speed of planets is very great (67,000 miles per hour for earth, 54,000 for Mars and 79,000 for Venus), even a slight error in timing and speed may cause a complete miss. And if you miss, you very likely will wander through space for ever.

That's the problem.

Now there are two methods we can use to guide a ship through space. We can give it precise speed and direction initially, as if it were shot from a gun. Or we can launch it with a reasonable degree of accuracy, and correct the course subsequently during the flight.

The first is called the "ballistic" method. Hitting Mars ballistically is about as easy as shooting a swallow from half a mile away with an arrow

MID-COURSE GUIDANCE

The second method, known as mid-course guidance, is the most practical and also the most reliable because it allows for continuous correction of errors in the trajectory.

In order to use midcourse guidance, we must know certain facts: The ship's position, the ship's speed, the ship's direction of travel and the "future position" of the destination at the expected moment of arrival.

The last of these facts — the position of a planet at a given moment — we know very accurately from astronomical tables.

Two of the remaining facts — the ship's position and speed — can be determined from within the ship, or by observing the ship from the earth and relaying the information to the ship. (This is an excellent field for inventors who can offer sound and simple solutions.)

One practical solution is shown in Figure 2. In this solution, the ship is tracked by radar on earth. Each radar impulse from earth triggers a "transponder" on the ship, which answers with a powerful radio impulse. The time interval between the radar pulse and its echo can be used to determine the distance of the ship from earth.

MEASURING SPEED

Using the same system, we can measure the speed of the ship. Have you ever waited for a train at a crossing and listened to its whistle? Just as the train passes, the sound seems to drop in pitch. This is known as the "Doppler effect." Here's what happens: Because the train is moving, you in effect are "running away" from the train's whistle and its sound waves. Therefore you receive fewer waves, and the pitch of the whistle seems to drop. The same phenomenon applies to radio waves. The frequency drops as the receiver moves away from the transmitter and increases as it moves toward the transmitter. By measuring this change in frequency we can determine the ship's speed.

Actually, for a really accurate speed measurement we need three different "speed fixes" from three different radars on the earth's surface.

We can determine the ship's direction by measuring the angles as shown in Figure 2. One angle is the latitude of the transmitter itself. The other two show the azimuth and elevation with respect to the earth's surface.

Thus the radar-beacon system will

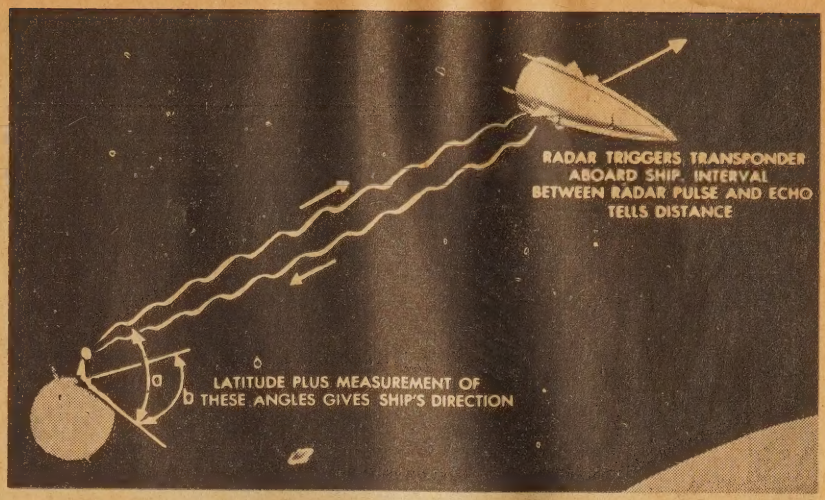

RADAR TRIGGERS TRANSPONDER ABOARD SHIP. INTERVAL BETWEEN RADAR PULSE AND ECHO TELLS DISTANCE
LATITUDE PLUS MEASUREMENT OF THESE ANGLES GIVES SHIP'S DIRECTION

Fig. 2. Measurements of radar signals and their echoes will determine the course and range of the spaceship.

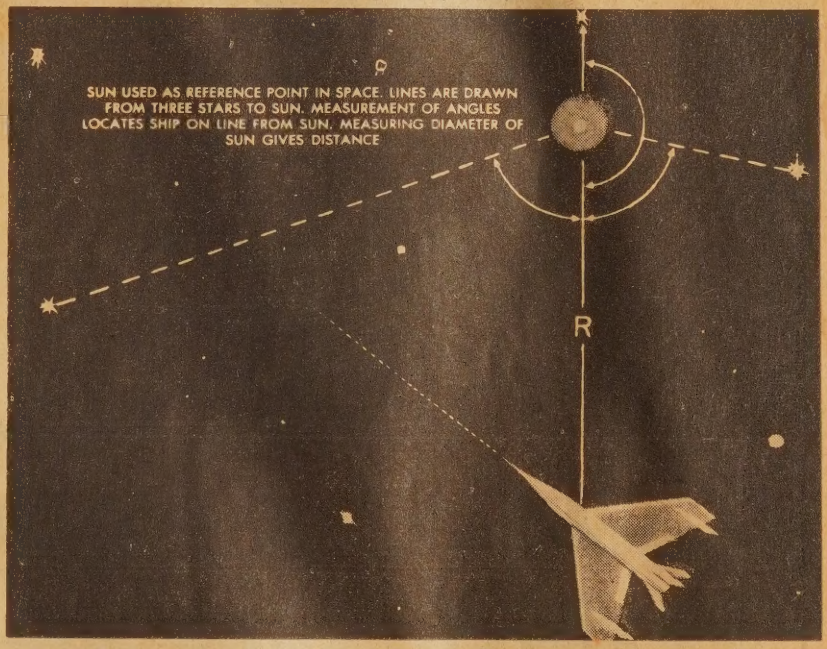

SUN USED AS REFERENCE POINT IN SPACE. LINES ARE DRAWN FROM THREE STARS TO SUN. MEASUREMENT OF ANGLES LOCATES SHIP ON LINE FROM SUN. MEASURING DIAMETER OF SUN GIVES DISTANCE
R

Fig. 3. Position can be fixed from inside ship by measuring angles of three reference stars and the sun.

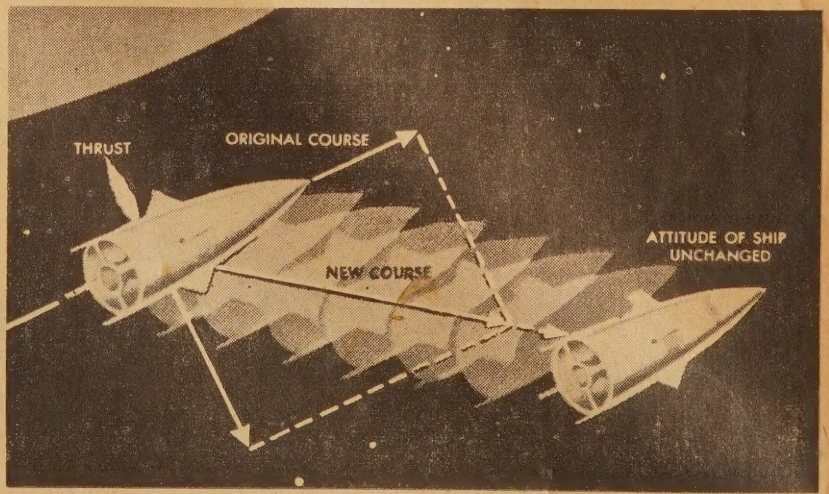


Fig. 4. Spaceship must use rockets to change not only course, as shown above, but also attitude of ship.

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Thomas was the first Company to produce a 21-inch picture tube in Australia. It was a 90-degree aluminised tube with electrostatic focus, incorporating a "bent" gun and ion trap. Public acceptance of the larger picture soon established 21-inch tubes as the most preferred size in all makes of receivers.

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yield three facts: The ship's distance its direction and its speed.

Another method is for the crew of the ship itself to determine its position. All it needs is a "frame of reference." Such a method is shown in Figure 3 In this case we select the sun as the basis of the frame of reference, and also three stars. The navigator draws a line from each star to the centre of the sun. His fourth line is from the ship's position to the sun, and he determines this by measuring the angles from the other three lines.

So far, all he knows is that the ship lies somewhere along this fourth line Now he measures the apparent diameter of the sun, and he can determine his distance from it, thus completely fixing his position. The only remaining fact he needs is his speed and he can determine this, once again, by the Doppler effect, which causes the shift of certain components of the stars' light.

USE OF COMPUTORS

So far we have been concerned with the precise position of the ship in space, its speed and course. Now that we have this information, what do we do with it? We feed it into computers to calculate whether there are any errors in the "orbit" or course of the ship and, if so, what corrections we must make.

Now we transmit these corrections to the ship for action. But here we face even further difficulties. We can't turn the ship like we do an aeroplane, simply because there is no air to act upon control surfaces. We can alter direction only by firing side rockets.

We can alter speed only by firing tail or nose rockets. In Figure 4 the ship is proceeding along its course as indicated. A correction must be made, so a side rocket is fired. The new course of the ship is indicated by the second arrow, and is determined by the amount of thrust imparted by the side rocket.

But in doing this, still another difficulty arises. How can you impart a precise amount of side thrust when the ship itself may be moving backward, sideways or even tumbling and spinning along its course? Obviously to perform any correction you must first straighten out the ship along the ship-radar line of sight.

RADAR CORRECTION

Again there are numerous ways we can solve the problem. One rather simple method is to use the radar pulse itself If you dip your finger in a tub of water, you cause circular ripples to expand outward across the two-dimensional surface. Similarly, if you send a radar wave through three-dimensional space, the wave travels outward in an ever-expanding sphere. Figure 5 shows how we can take advantage of this. We mount four different antennas, which pick up the signals in phase, on the rear of the ship. When all four are equal, the ship is oriented on a direct line from the radar. If the phases are unequal, the ship can be straightened out by spinning masses, much like flywheels, inside the vessel.

Next the ship is rotated around its axis to bring the correcting side rocket into the proper position.Then the rocket is fired for the proper length of time. Subsequently other checks of the ship's position and trajectory must be made, and other corrections ordered if necessary, throughout the trip.

One of the big difficulties of such trips will be the effect of the enormous distances on communications. You can't pick up a radio telephone, say "Hello," and expect to get a prompt answer. Radio waves travel at a speed of 186,000 miles per second. Even at this speed, communicating with a spaceship in an orbit around Mars will be time consuming. For example, when Mars is at its closest approach to earth, it will still take a good 4½ minutes for a message to be received after it has been transmitted. Obviously there seems little point in a telephone conversation in which the initial "Hello" is answered nine minutes or even nine hours later.

It is a fair bet that interplanetary messages will be telegraphic rather than voice, and that great emphasis will be placed on condensing the "message" into as few words as possible.

It is obvious that great problems must be overcome if we are not only to "reach for the stars" but actually reach them — or at least the planets in our own solar system. But it is equally obvious that answers exist to each of these problems.

There is little doubt in my mind that man, now that he has succeeded in attaining escape velocities with his rockets, will himself escape from his mother planet and, using the immutable forces of nature to control and guide him, set off to explore his solar system.

GERMAN TV TRAFFIC CENTRE

Police in Munich, Germany, from this switchboard can control all the traffic lights in the city and, with the aid of radio reports from police cars, regulate traffic flow. At the same time, through a TV circuit, the controller watches the situation at the Karlsplabz, one of Europe's busiest crossings, on a large screen near at hand.

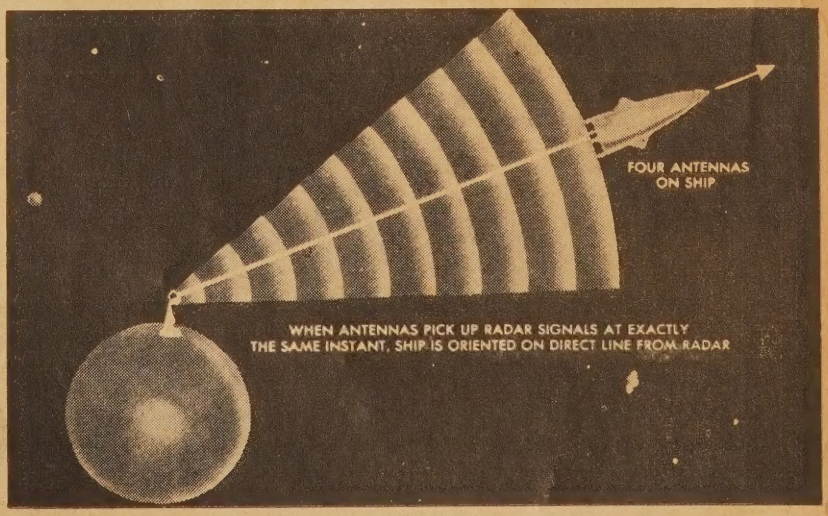
FOUR ANTENNAS ON SHIP
WHEN ANTENNAS PICK UP RADAR SIGNALS AT EXACTLY THE SAME INSTANT, SHIP IS ORIENTED ON DIRECT LINE FROM RADAR

Fig. 5. When four antennas on a ship pick up radar signal in phase, ship is in line with radar beam.

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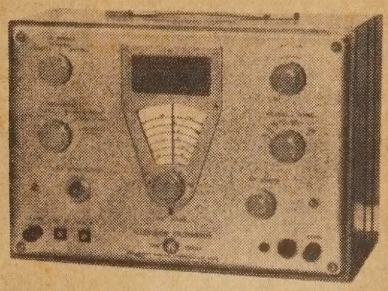

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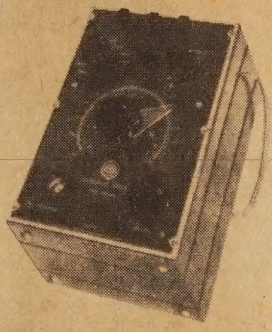

UNIVERSAL BRIDGE TYPE A56048

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Capacitance range: 10 μμF to 10 μF.
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Percentage measurements: −20% to + 25%.
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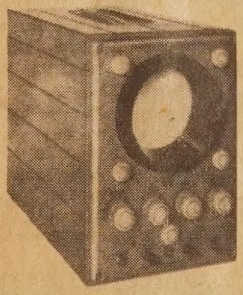

OSCILLOGRAPH TYPE A56031

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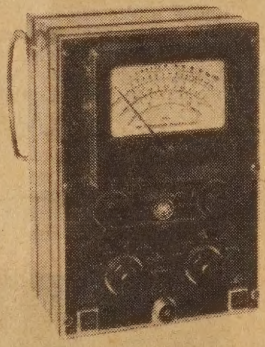
Sensitivity: 10 mV RMS/inch.



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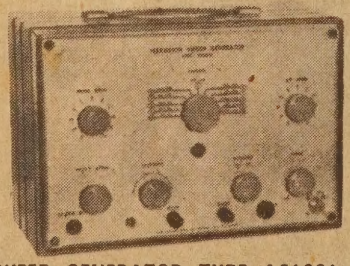

SWEEP GENERATOR TYPE A56036

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Sweep width: 0 to 10 Mc.
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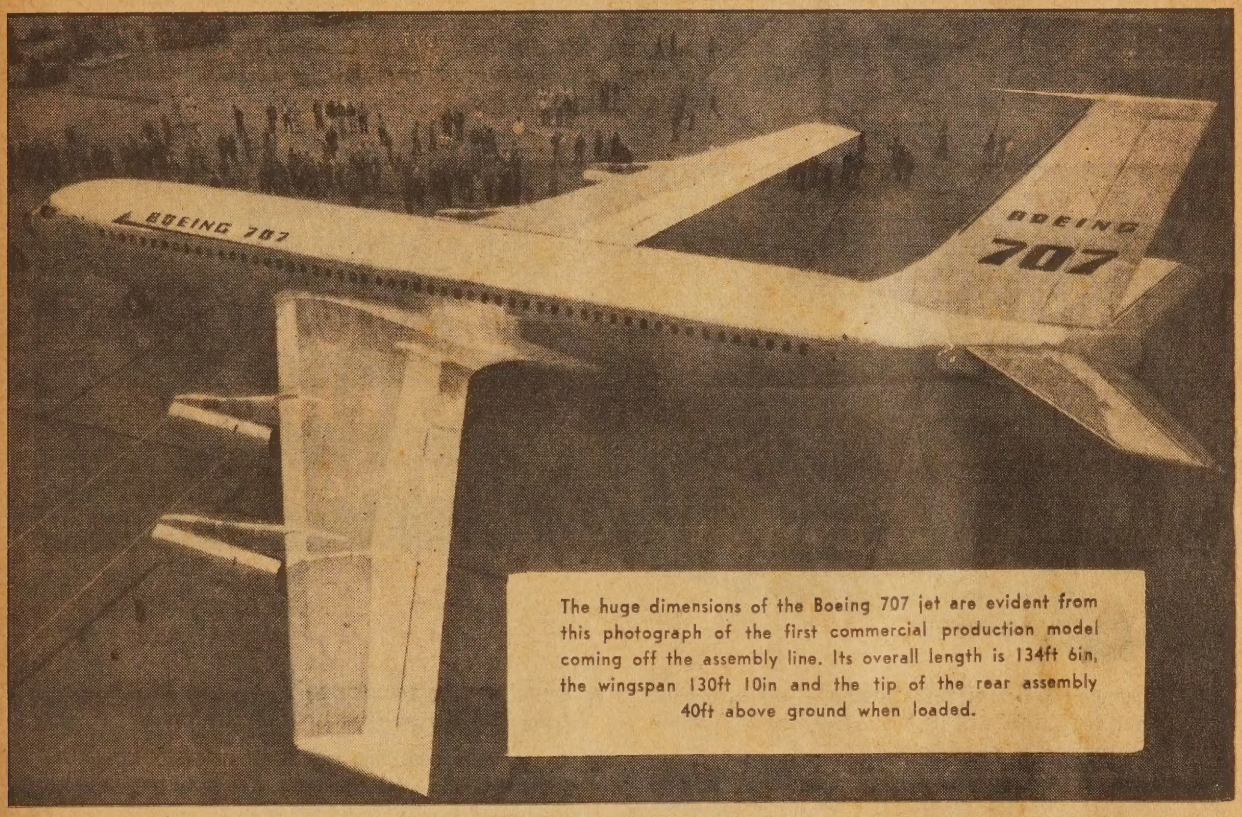


The huge dimensions of the Boeing 707 jet are evident from this photograph of the first commercial production model coming off the assembly line. Its overall length is 134ft 6in, the wingspan 130ft 10in and the tip of the rear assembly 40ft above ground when loaded.

Australian aviation history will be made when the first Boeing 707 jet stratoliner comes into service with Qantas Empire Airways this year. The Australian version will have a cruising speed of between 500 and 600 m.p.h. and carry up to 120 passengers in perfect comfort high above the weather.

STATISTICS on the aircraft give an appreciation of the staggering engineering problem in bringing it into physical form.

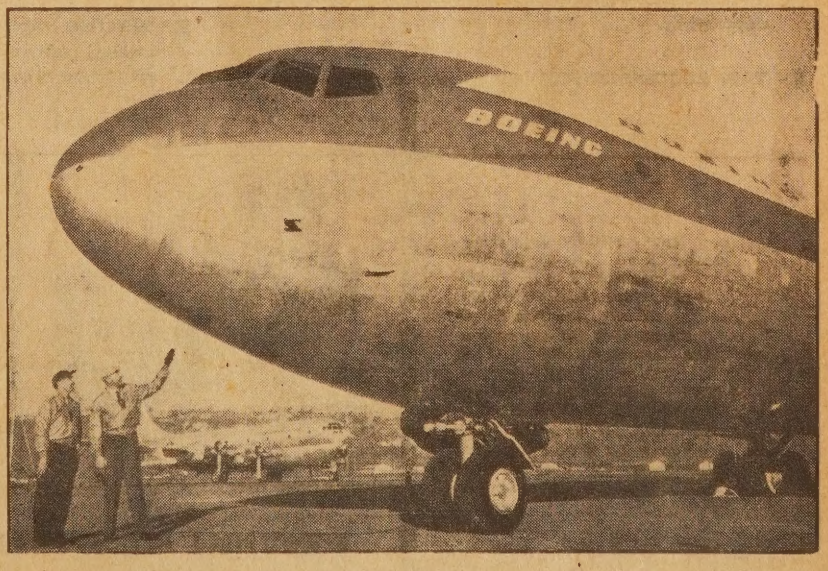
The overall weight, for example, of the 707 is 110 tons — against 60 tons for the Super Constellation. Speed is 550 m.p.h. against 275 m.p.h. for the Super Constellation.

Total fuel capacity is 14,500 imperial gallons stored in seven huge nylon and rubber bladder cells enclosed by the wing structure. At takeoff the wing of the 707 is a huge reservoir of aviation kerosene.

Four Pratt and Whitney turbojet engines are strut mounted in pods beneath the wing. A thrust reversing device is provided to give a 50 per cent reverse thrust to slow the landing run. A total of 609 gallons of water is carried to supply the water injection system which provides additional thrust during take-off.

Electrical power for the aircraft is generated by four 30 kVA 400 cycle 3-phase generators driven from the engines through constant speed drives. Some of this power is used to operate equipment in the aircraft directly, while some is fed to transformer-rectifier units

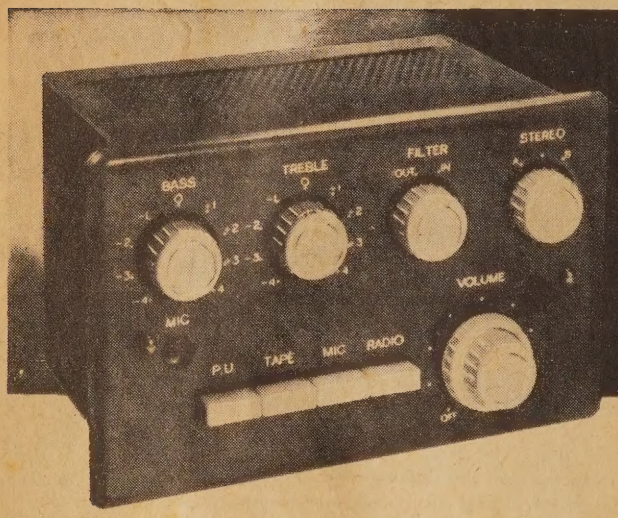
(Continued on Page 105)



Nose wheels are steerable to aid in manoeuvring the aircraft on the ground. Tyres look small in this picture but they are actually 39in by 13in size. Compare this with your car!

This entirely new unit incorporates every essential requirement for High-Fidelity, STEREO reproduction from Tape, records and Radio. Provision is also made for monaural operation, including Microphone and Tape Record. Versatile, the unit may be used with two JUNIOR or two CADET Amplifiers, while owners of a JUNIOR Amplifier may, if they wish, use a CADET as the second amplifier. Compact, the unit is directly interchangeable with the RD JUNIOR Mk. II Control Unit and styled to match other RD JUNIOR Units.

PRICE: £48/10/- Retail



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- **HIGH PICK-UP SENSITIVITY,** sufficient to operate from any pick-up in the world, including low output variable reluctance types.
- **RECORD COMPENSATION** conforming to current RIAA LP characteristic.
- **TAPE RECORD SOCKET** for single channel recording.
- **TAPE REPLAY SOCKET** for stereo replay direct from tape replay head. Incorporates CCIR 7½" characteristic.
- **DUAL CONCENTRIC VOLUME CONTROL** simplifies balancing problems and permits use of dissimilar main amplifiers. For example one JUNIOR and one CADET.
- **SWITCHED GANGED LOW PASS FILTER** carefully chosen to produce maximum effect in reducing distortion experienced from poor radio transmissions or worn records.
- **WIDE RANGE GANGED TONE CONTROLS,** continuously variable Bass and Treble controls using Baxandall circuit.
- **STYLING** matches existing RD JUNIOR equipment and is available in same colour range. Installation identical to RD JUNIOR Mk.II Control Unit

Input Sensitivity—Tape (Playback): 2.5 m/V. Pick-up: 2.5 m/V. Microphone: 5 m/V. Radio: 25 m/V. Tape (Record): Output 100 m/V. Low Pass Filter: 8 kc/s. 15-18 DB per octave. Bass Control: +14DB. —16DB. (50 cps.). Treble Control: +12DB. —18DB. (10 kc/s.). "Cross Talk": 40-45 DB. Consumption: 6.3v., 1.4A, 180-300v., 2-3.5 m/A. Valves: 2 x EF86, 3 x ECC83. Dimensions: 8½" x 5½" x 5⅛". Weight: 6 lbs.

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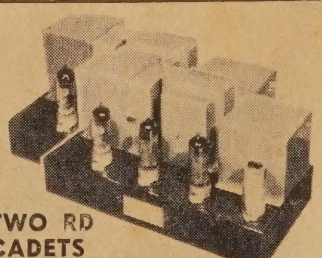

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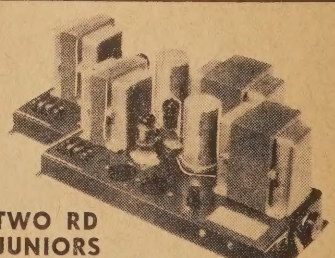

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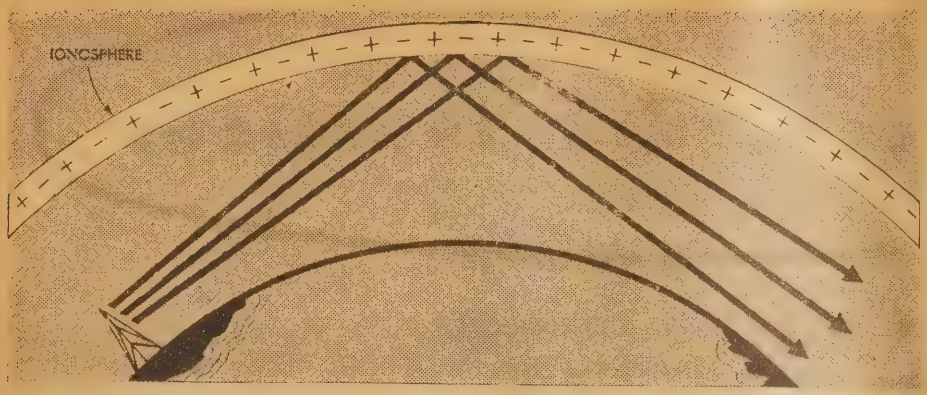


Fig. 1.—How frequency signals are reflected from the ionosphere, and return to earth to provide "skip" reception over long distances.

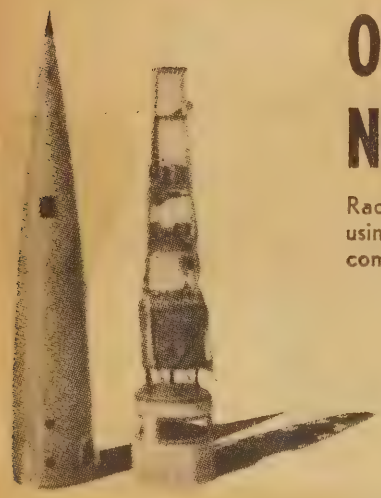
☆

By Michael Gladych

☆

OPERATION 'SMOKE PUFF' PROMISES NEW USES FOR MICROWAVE SIGNALS

Radio amateurs co-operated with propagation scientists to examine a method of using artificially produced ionized layers to provide a new and interesting means of communication. It has many possible uses, particularly in the field of defence.



The nose cone and "innards" of the rocket look like this.

MILITARY radio, nerve system of defence, has been under a serious handicap. The enemy can eavesdrop and jam broadcasts. Besides, the static-free microwaves used in communications and the guiding of missiles do not go beyond the horizon, thus limiting the range. But recently, a group of U.S. Air Force scientists solved the military-radio problem with an ingenious "radio mirror."

Released by rockets at high altitude, that mirror can now give radio the privacy of a telephone line. It can help guide missiles over a very long range and it can act as an electronic camouflage against radar-snooping sputniks. And as a peacetime bonus: the same mirror could improve FM and TV coverage and even illuminate cities with a moonlike glow.

REFLECTED WAVES

Developed under the Operation "Smoke Puff" — a project of the Air Force Cambridge Research Centre in Bedford, Mass., this jack-of-many-trades works on the radiowave reflecting principle of the earth's ionosphere.

In this electronic age, everybody knows that the ionosphere is an electrified upper-air region that bounces off radiowaves around the globe, making long-distance radio communication possible. The ionosphere is always there at between 60 and 70 miles up. Sunrays on their way down shear off electrons from the atoms of air. These crippled atoms develop an electric charge and become radio-reflecting ions.

However, the earth's ionosphere acts as a built-in mirror only for low-frequency radiowaves. (Fig. 1.) The high-frequency waves go through it like bullets. (Fig. 1A.) Of course, on occasions when the solar-radiation bombardment is particularly severe, the natural ionosphere can develop patches dense enough to bounce off shortwave signals, even with the ultrahigh TV broadcasts.

It was those freak radio bounces that gave scientists the idea for the Smoke Puff project.

"Those high-density irregularities of the ionosphere are unpredictable," says Dr Frederick F. Marmo, the chief of Operation Smoke Puff. "But if we could make a high-density ion patch, we should be able to reflect even the microwaves at will and literally anywhere."

To make the artificial ionosphere, Dr Marmo used metallic potassium. "Potassium is especially good for the purpose," he says, "because each potassium atom has an odd electron just begging to be knocked off by solar radiation. That's how we can be sure of getting a high condensation of ions up there." And reaching the upper air was no problem for the proved Aerobee rocket.

The Smoke Puff Aerobee carried some 15 pounds of potassium in a special container, rigged to explode at 60 miles of altitude. The heat of the explosion would vaporise the potassium cargo which would form a cloud — hence the code name: Smoke Puff. Now, the sunrays would shear off the unstable electrons and turn the potassium atoms into ions.

AMATEURS HELP

To test the radiomirror properties of that potassium cloud, Dr Marmo alerted amateur radio operators within a 700-mile radius of the mid-desert Holloman Air Development Centre in New Mexico where the Smoke Puff rocket launchings took place. They were to send radio signals in the 14 to 144-megacycle range and report on how good the long-distance reception would be.

The first Aerobee misfired its potassium. But the next one created an ion cloud so dense that even Dr Marmo was amazed. For 45 minutes the cloud mirrored the ham broadcast and gave a next-door-clear reception over several hundred miles (Fig. 2).

Having proved the soundness of the radiomirror idea, Dr Marmo and his associates, L. Aschenbrand and J Press

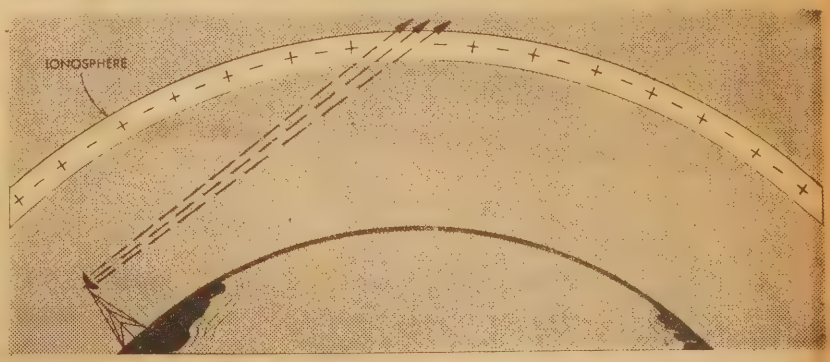


Fig. 1A.—Unlike low frequency waves, high frequency waves shoot through the ionosphere like bullets.

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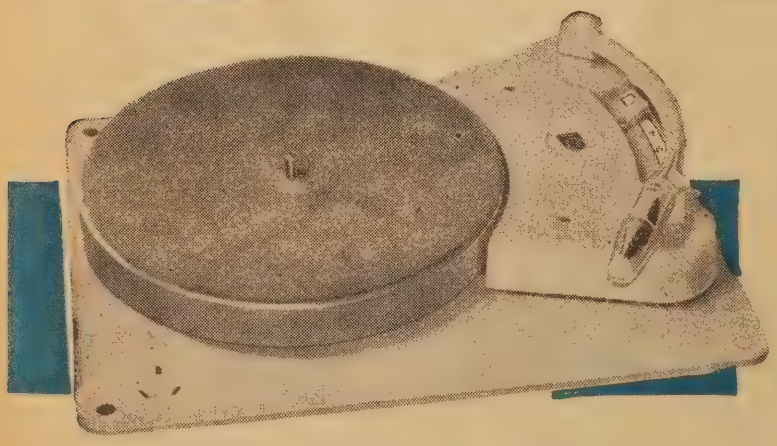

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man, are now working on the next step. The experimental Smoke Puff ion cloud had the shape of a thick pancake, the scientists believed.

Such a shape bounces off radio signals in all directions, and the problem is to make the cloud reflect radiowaves in a predetermined course. That's why Dr Marmo's crew is trying to make special oblong clouds that would channel the radio waves into a narrow beam.

Now, suppose a submarine at sea is trying to establish radio contact with the home base. It fires a small rocket that pops a potassium cloud pointing to the base. The sub's radio beams its microwave signal at the cloud, and the reflected and narrowly channelled waves are received only in the immediate vicinity of the home base.

Since the enemy radio-monitoring stations don't know where the ion cloud is, and in which direction it points, the sub can talk with its base without fear of being overheard.

POSSIBLE USE

A similar trick would work with guiding long-range missiles. At the moment, the microwave guidance is limited by the earth's curvature. But with an ion-potassium cloud placed in a certain spot ahead of the missile's course, the "bird" could be coached by a radio beam all the way to the target. And the enemy radio-jamming stations, unable to detect the narrow beam, would not be able to confuse the missile's electronic brain.

An interesting offshoot of the Smoke Puff ionosphere would be its shielding property. We are already grooming a radar-reconnaissance artificial satellite, and chances are the Russians are doing it, too. But since radar works on very high frequency radiowaves, those waves could be reflected by a large Smoke Puff cloud placed over a military target or a city. The result: The sputnik's radar eye could not see through the ion camouflage.

DAYLIGHT ONLY

At the moment, the Smoke Puff cloud can be ionised only during daylight hours. However, Dr Marmo is planning an improved version that would work equally well at night. From the military point of view, that nocturnal manmade ionosphere might have a drawback — it would emit a glow. This would be a dead giveaway. But for peacetime application, the glow of a large and longer-lasting ion cloud could be used to illuminate a city better than the street lamps.

And to the FM enthusiasts and the ever-growing number of TV viewers, Dr Marmo's ion cloud would be a boon. Strategically placed ion clouds could easily cover the entire country, eliminating the eye-and-ear strain of fringe areas.

Naturally, the rockets are expensive, but mass production and improved methods would, in time, bring the cost down. And as for the potassium, Dr Marmo says it costs no more than ordinary, run-of-the-mill baking flour.

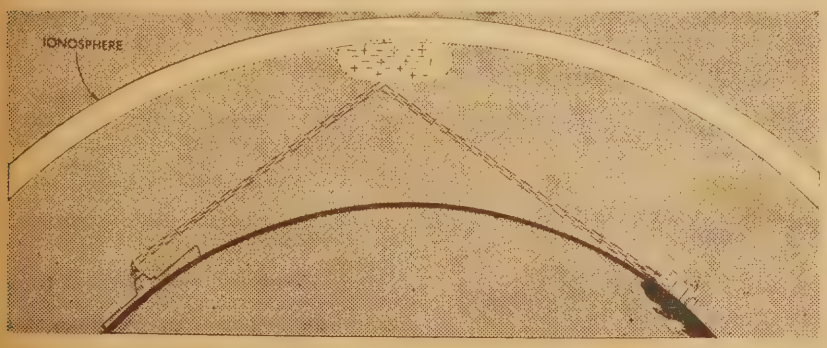
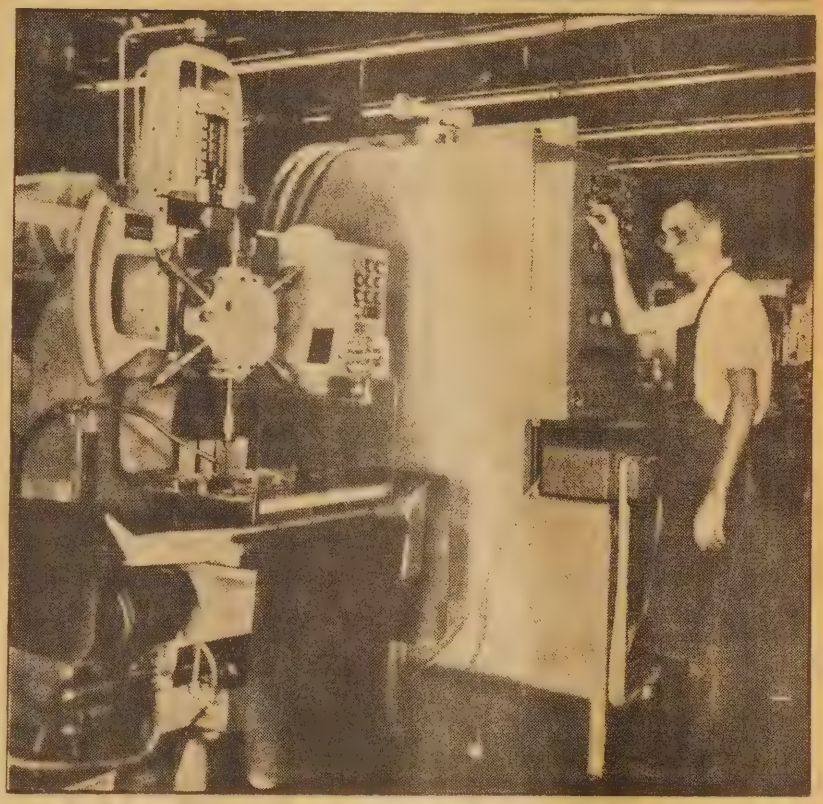


Fig. 2.—The ions mirrored a broadcast for 45 minutes and gave clear reception over hundreds of miles.

TAPE CONTROLS MACHINE DRILL



Records show that production saving of between 32 and 95 per cent can be effected by the use of a tape control system with a general purpose drilling machine on short-run component schedules.

THE control unit involved in the test and pictured above was the General Electric "packaged numerical control system Mark II."

The six-spindle, general-purpose drill takes punched tape "commands" from the pre-engineered "Mark II" Control package. A tape reader in the control system reads the tape, sends signals to the drill, checks the motion of the machine within prescribed limits, and — when the workpiece has been properly positioned — "instructs" the machine to drill into the part. This sequence is repeated until all holes in the workpiece have been machined. At the end of the drilling cycle an audible signal is automatically set off to alert the operator that the run has been completed.

The "Mark II" packaged-unit consists of the main control cabinet, an operator's station, punched-tape reader, two Thymotro adjustable speed drives, and two position pickup units.

As an example of the savings already achieved by use of the new tape controlled drill, Specialty Control manufacturing engineers listed the following:

(1) Drilling of 21 holes in a mounting foot for a static exciter — used in the electrical system of a supersonic jet fighter — dropped set-up and operating time 69 per cent on seven lots of 61 pieces each. An expensive drill jig was eliminated in this application.

(2) Previously, 133 holes were punched into a diode cover, one at a time, on a punch press. Using the new equipment, 10 covers are stacked and drilled in one set-up, resulting in a 95 per cent production saving and, again, eliminating special tools.

An Australian development used in the Antarctic. Salt water from the tanks feeds into the evaporation chamber through a regulator and is recovered as fresh water. The sun's heat operates the evaporation.

Making Fresh Water From The Sea

The increase in world population and the wide ramifications of modern industry has created serious problems connected with the supply of fresh water. Scientists are still meeting with the problem of converting sea water on a useful and economical basis.

by Calvin Walters

LIFE cannot exist without water of some kind. Some creatures must have salt water and some must have fresh water.

For the purposes of the human being, birds and animals, the water must not only be fresh, it must be relatively pure and free from bacterial contamination.

It seems a strange anomaly of nature that salt water covers three-quarters of a planet made for fresh-water-using creatures.

WHY SEA IS SALT

Why were they not made to use salt water? This question has often been posed but after a few minutes consideration it will be seen that there are many obstacles to a satisfactory answer. One might also ask—Why are the oceans not fresh?

If we take the last question first we find that the oceans cannot be fresh. The salts of the elements in the earth are soluble in water and therefore must become dissolved in the water as it flows into the oceans.

Now we might say why make the salts soluble in water. Why shouldn't they be insoluble? If that were so man would indeed be in dire difficulties. There could be no medicines for the sick, mum's wash day would be one of complete frustration, our food supplies would be jeopardised, there would be no beer, soft drinks or lollies. Chemistry would be impossible, industry would languish, there would be no gardens or sports fields.

Indeed, one could write pages about the disastrous effects of water being a non-solvent, for all the processes mentioned depend on the dissolving of salts in water and as these salts are present in the earth it follows that the water of the ocean could not be fresh.

On the other hand if man, birds and animals were made to live on salt water an entire new concept of life would be necessary. All the processes mentioned earlier would be impossible in their present form. Fresh water rain would then become a problem. It would have to RAIN salt water so that we could have salt water dams and rivers and water supply systems.

For this we would need non-corrosive pipes and containers and so on.

FRESH WATER VITAL

It is questionable anyway whether we would be any better off. Those living near rivers and oceans would still have plenty of water just as now, while those in other areas would still need to have the water conveyed to them, just as now.

Taken all round, the fresh water system seems to be the better deal for everyone.

Of course, it would be a great boon to humanity if means were found to remove the salts from sea water thus converting it into fresh water for human consumption. We would then have an unlimited supply.

On a small scale this has been taking place for a very long time. Most passenger ships, navies, isolated miners all over the world, and scientists in lonely outposts use the process of distillation to produce fresh water from sea water or brackish swamps. More will be said of this process later. In the meantime let us see just how much the world needs an effective means of making salt water into fresh.

In addition to ordinary domestic needs of the individual which has been estimated at about 20 gallons a day, industry makes the greatest demand on water supplies.

When it is considered that it requires 300 gallons of water to make a keg of beer, 60,000 gallons to make a ton of steel, and a few million gallons to run a paper mill, it will be appreciated just how much water is required by industry.

As more beer is being drunk, more steel being made, and more paper being used every day as industry expands, the demand is becoming greater year by year.

To keep Government departments alone going with paper must require a considerable amount of water.

GREAT QUANTITIES

To all this must be added the tremendous volume required in the food canning industry, and confectionery trade, not to speak of the millions of gallons drunk in patent medicines and soft drinks.

In Sydney a water shortage occurs even if the weather forecaster forecasts a hot day.

All the deserts and waste places of the earth are evidences of lack of water. Even where the oceans lap the shores of

deserts there is no prospect of "making the deserts blossom as the Rose" as it says in the Bible unless ways are found of converting the sea water.

As mentioned above the process of distillation has been known for centuries. It consists merely of boiling the salt or brackish water, and passing the steam through cooled pipes in which the steam condenses into pure water which runs from the pipe.

Some of these stills which are used on shipboard can convert enough sea water for normal usage between ports. On a large scale however, the process is rather costly.

HUGE EVAPORATORS

Nothwithstanding this cost, the Kuwait Oil Company on the shores of the Persian Gulf installed six huge evaporators and converted 700,000 gallons of salt water daily into drinking water. This was in 1950. The effectiveness of the method caused the local king, Shah, Sheik or whatever he is called to install 10 more to supply water to his capital city. Thus the Kuwaitis have no longer to rely on small wells for their water supply thanks to a kindly ruler.

These evaporators are extremely effective in producing good water. How good is seen from the fact that the water contains less than one hundred parts per million of salt. The Persian Gulf water from which it is produced contains 40,000 parts per million of salt. Water is good to drink if it contains less than 1,000 parts per million of dissolved salt.

There are other places which are using this system notably Curacao and the Dutch West Indies. These are very hot places and water evaporates quickly. With the discovery of oil, the oil companies installed evaporators with the result that a million tons of fresh water is produced from the sea each year.

One of the greatest obstacles to the distillation process is the fact that at temperatures above 160 degrees Fahrenheit, certain salts are precipitated from the salt water, and accumulate in the form of scale on the boiling surfaces. This retards heat transfer and tends to block up any pipes in the system..

Under such circumstances maintenance costs are a problem to the economical production of fresh water.

COST PROBLEM

Much research has been directed to try to overcome this obstacle and some success has been achieved. One method makes use of thin films of water flowing at high speed over surfaces at less than scale-forming temperatures.

The surfaces are conical in shape instead of the usual tubes. Enough steam is produced with less fuel to give a very effective distillation.

The use of the heat from the sun to distil water has been an attractive idea for a long time. It was put to good use during World War II when Dr Marie Telkes, director of the Solar Laboratory in New York University devised a small still for use on life rafts at sea. This saved the lives of many shipwrecked sailors and airmen. The portable evaporator produced about a quart of fresh water per day from sea water.

Carrying the idea further Dr Telkes has devised a solar still which looks like a miniature house. It consists of a black tray holding a shallow layer of salt water resting on a layer of heat insulation. The tray is covered with a roof type enclosure of glass or plastic.

War time still used by flyers. It is inflatable plastic bag containing sponges which are saturated with sea water. The heat of the sun evaporates water from the sponges which condenses on the inside of the bag and runs down to an internal trap.

This simple device is a plastic bag which is filled with sea water. A special briquet is inserted through which the water is filtered to remove the salt. Filtering is a chemical action which precipitates the salt.

The heat of the sun shining through the glass heats the water and generates steam which condenses into fresh water on the inside of the glass. It then runs down and is collected in a gutter on the lower edges of the glass roof. On clear days with strong sunshine up to one and a half pounds of fresh water is produced daily from one square foot of evaporator pan.

EVAPORATORS

It has been found that more solar energy is collected when the surface is tilted, consequently Dr Telkes devised the tilted evaporator.

This consists of a sheet of black cloth suspended between two sheets of glass. Salt water is fed on to the black cloth. Sun shining through the glass evaporates the water on the black cloth and the steam collects on the inner glass surface and trickles down to an outlet.

By facing the still in the direction of greatest solar energy there is an increase

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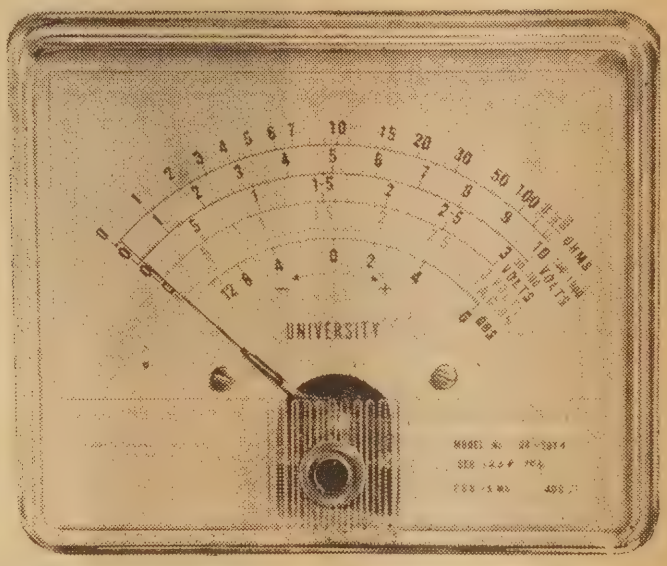

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of 40 per cent in efficiency as against the flat still described earlier.

Another type of solar still makes use of the same type of construction, as just described, except that special plastic sheets replace the glass panes.

One great advantage of this type of evaporator is that, because there is no glass in the construction, it can be rolled up and transported from place to place as required. It will also withstand high winds and can easily be repaired if torn. It has been estimated that an acre of this type of still will produce 5,000 gallons of fresh water per day from salt or brackish water.

The attractive possibilities of this method of producing fresh water in arid and desert regions are enormous.

SEPARATING THE SALT

Plans are already afoot to establish such stills on a large scale. The great feature, aside from those mentioned, is the low cost both in construction and the fact that no fuel is needed It does not require continuous strong sunshine to produce the water. Some water will be produced even on cloudy days.

The simple construction of the evaporator is shown in a diagram herewith.

Another method of producing fresh water from salt water uses cold instead of heat. In other words a freezing process.

When salt water freezes the ice crystals are fresh water but they trap between them the "mother liquor" which is salt.

The problem with this method is to free the pure fresh ice crystals from this mother liquor.

Experiments have been carried out with ice in many forms such as crushed ice, flaked ice, blocks and tubes and so on.

So far no economical method of separation has been devised although considerable research is still being conducted.

Separation has been effected by compression, centrifugal force and so on but the method is still far from a good proposition.

A unique idea is being investigated which might prove a winner if certain special solvents can be found. The idea was enunciated by Dr Hood and Dr Harwell of Texas.

They suggest that fresh water may be extracted from salt water by the use of certain organic solvents.

USE OF SOLVENT

It is necessary to find a compound which, while being itself insoluble in water, will absorb large quantities of water. It must extract fresh water from salt water and release the fresh water when the solvent is moderately heated.

This seems a tall order but believe it or not good progress has been made. It is now technically possible to extract fresh water in this way. Some 150 different solvents have been discovered. It only remains to find the most efficient and the best way to recover the solvent from the fresh water.

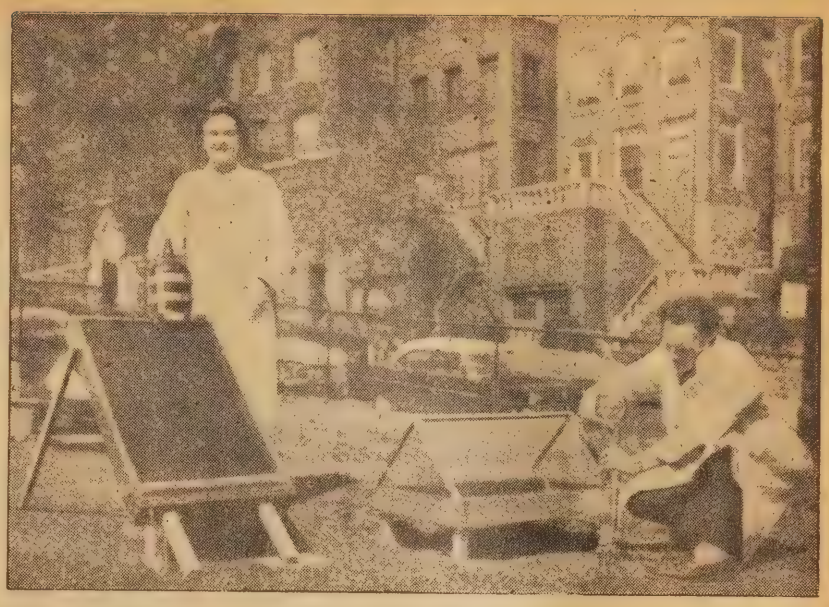
The most exciting process and one which holds most promise for its ability to produce large quantities of fresh water quickly is the electric membrane process.

This process is a little more difficult to describe as it is rather more technical.

The salt in salt water consists of sodium chloride. This is derived from sodium and chlorine. The sodium particles are electrically charged with a positive charge and the chlorine particles carry a negative charge.

Now we all know that unlike poles or charges attract each other.

If then we put two electrically charged poles into salt water one pole being positive and the other negative, the positively charged sodium particles will move toward the negative pole and the negatively charged chlorine particles will move toward the positive pole. The water is thus demineralised and will become fresh, being deprived of its sodium chloride. Sounds complicated but read it again before we proceed.



Two types of stills—the flat type and the roof-top type. Both rely on the sun's heat.

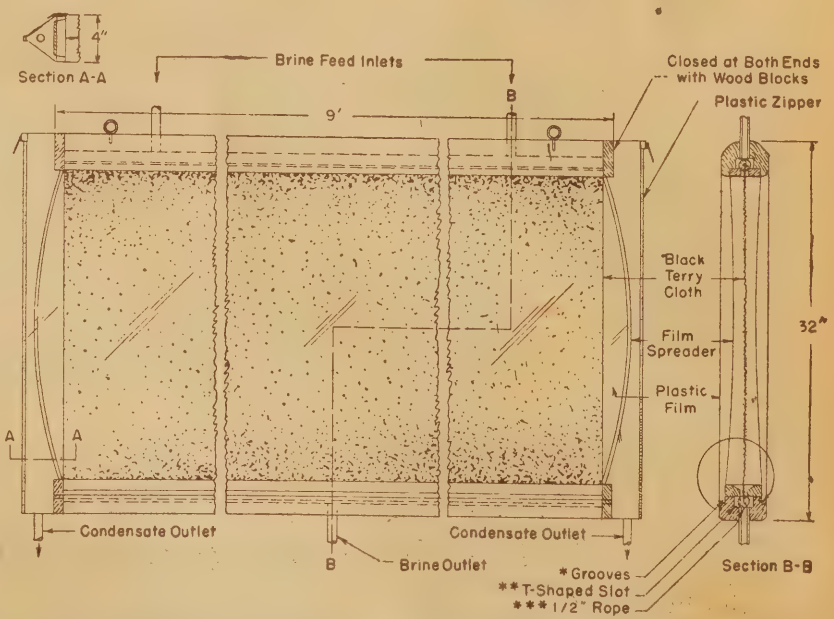
Plastic membranes have been developed which are electrical in character inas-much as one membrane will allow only positively charged particles to pass through it whilst the other will allow only negatively charged particles to pass through.

Thus in the required apparatus one membrane allows sodium to pass and the other allows chlorine to pass.

Now if you can imagine a unit consisting of 300 of these thin plastic membranes separated from each other by about one millimeter, each membrane being 18in x 20in, you will form a picture of the simple unit.

It therefore consists of 300 water com-

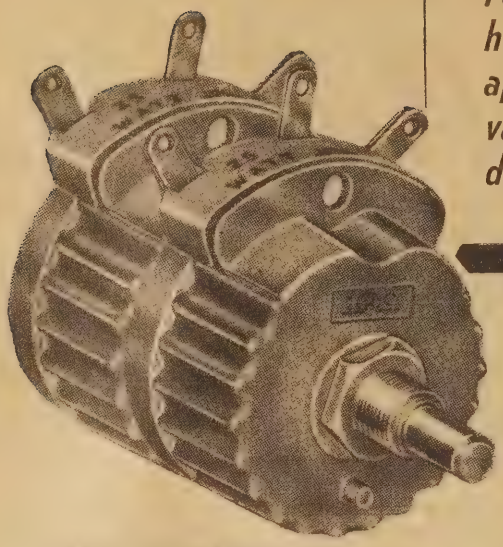
(Continued on Page 105)



* Grooves for Collecting Condensate
** T-Shaped Slot Cut into Cypress Used to Hold Fabric and Feed Sea Water
*** 1/2" Rope Sewed into Black Terry Cloth

A cross-section of the flat type of still.

* *For speed controls of fractional horse-power motors, and for all applications where continuously variable resistances of small dimensions are essential.*



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Power Rheostats

These rheostats are able to satisfy a wider range of the Industry's requirements than those of conventional design, because of IRC's maximum utilisation of heat-conduction through aluminium.

REAR VIEW SINGLE UNIT

FEATURES:

HOUSING. Ribbed die cast aluminium alloy case designed to conduct heat away from resistance element.

RESISTANCE ELEMENT. Low temperature coefficient wire uniformly wound on an insulated strip. Aluminium core ensures uniform heat distribution throughout the entire resistance element irrespective of how much is actually in service.

CONTACT. Contact is made to the radius edge of the resistance element by means of a special alloy which will not pit or stick. Contact pressure is maintained by a separate steel spring, not in the current carrying path.

CLOCKSPRING. A robust clockspring designed specially for these Rheostats connects the sliding contact to the centre terminal. Thus there is no conventional series pressure contact to introduce trouble at this point.

RANGES AND VALUES:

PR 25, 25w. in all values from 1 to 5,000 ohms.
PR 50, 50w. in all values from 0.5 to 10,000 ohms.

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Technical Review

AUDIO OSCILLATOR COVERS RANGE 3-30 CYCLES

Reprinted from 'Radio-Electronics,' this design for a low frequency audio oscillator will be of special interest to anyone desiring to check speakers or amplifiers in the sub-audible range.

THE little, inexpensive oscillator described here produces a very good sine wave from 3 to 30 cycles, supplementing the low range of present equipment.

Generating pure two-cycle sine waves is difficult, unless you are willing to use a beat oscillator actually containing two oscillators and producing the low-frequency sine wave by beating one against the other. A beat oscillator has the disadvantage that it is difficult to stabilise.

This little oscillator does not produce an absolutely pure sine wave, but it does not have more than a few per cent distortion.

It has turned out to be remarkably stable. The one critical part for stability is the Wien-bridge dual potentiometer (R1), which should be rated at two watts for satisfactory stability.

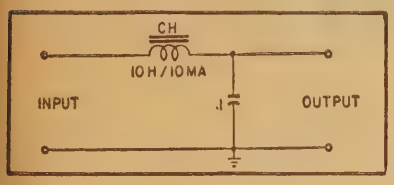


Fig. 2—Low-pass filter to reduce further the slight amount of distortion present in the sine-wave output.

Fig. 1 shows the complete circuit diagram. As you can see, it is a conventional Wien-bridge oscillator, but with very large capacitive values and more than usual number of filament lamps. (Thermistors have been used in some low-frequency units in place of the lamps to get greater stability.)

The extra lamps are in the cathode of the 6AQ5 feedback tube and help to clean up the waveform. V3 is a simple cathode follower which prevents oscillator circuit loading which would result in a frequency change.

With R5 at minimum resistance the oscillator just oscillates, but the wave form is purest at this point. Some distortion of the sine wave is visible at the lower peaks but it is not a very serious amount.

If you need a very pure sine wave at these low frequencies, the simplest solution is to include a low-pass filter network at the oscillator's output.

Fig. 2 shows a typical low-pass filter which will do a creditable job at all the frequencies produced by this oscillator, but it will, of course, result in some attenuation at the upper end of the range.

Attenuation is not a serious problem; the oscillator puts out (for most purposes) a large signal anyway. With the filter shown, no distortion could be detected visually.

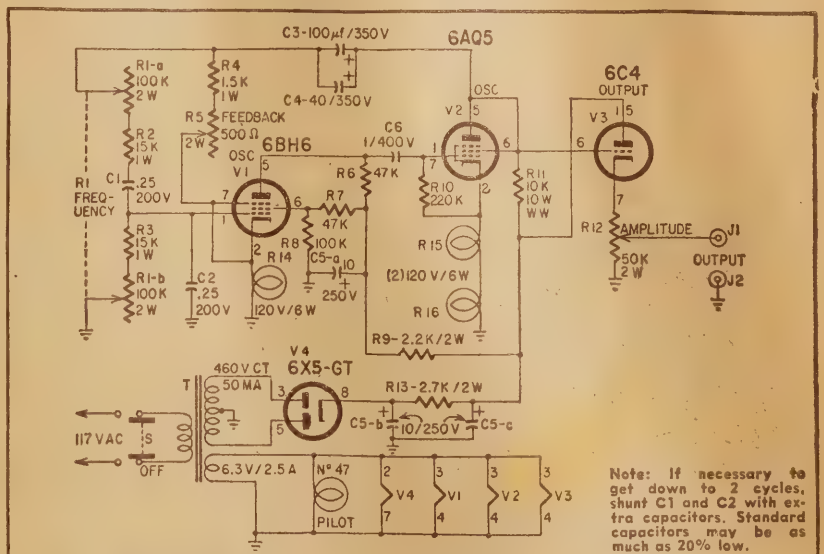
Other than testing amplifiers, scopes and speakers, what are some uses for this little oscillator? Well, you could use it to determine rumble frequency of a turntable by making Lissajous figures on a scope, using the oscillator for horizontal deflection.

You could amplify the signal with a very simple power amplifier and apply it to a solenoid to rock a photographic tray or tank slowly. You can apply the signal to a reactance tube to frequency-modulate another oscillator, giving a vibrato effect for electronic organs or other musical instruments.

Originally designed to provide a subsonic signal for psychophysiological tests, there are many other uses for it. An important use is in checking modern feedback amplifiers whose response below 15 cycles is important in determining stability.

Calibration is a simple process. The 30, 20, 15, 10 and 5-cycle points, and even three cycles, can easily be checked with Lissajous figures on an oscilloscope, using 60-cycle line voltage for comparison. Below five cycles, a stopwatch and counting will work.

[J1 is positive to ground, so use a blocking capacitor when feeding an amplifier that does not have one in its input circuit. Also, V3's bias may be upset when driving a low-resistance load. To avoid these difficulties, connect the positive side of a 250-volt, 100uF (or higher) electrolytic to the arm of R12 and the negative side to J1. Connect a 1-megohm resistor between J1 and J2. — **Editor.**]



R1—dual pot, 100,000 ohms, 2 watts, linear taper (Ohmite CCU1041 or equivalent)
R2, 3—15,000 ohms, 1 watt
R4—1,500 ohms, 1 watt
R5—pot, 500 ohms, 2 watts, linear taper
R6, 7—47,000 ohms, ½ watt
R8—100,000 ohms, ½ watt
R9—2,200 ohms, 2 watts
R10—220,000 ohms, ½ watt
R11—10,000 ohms, 10 watts, wirewound
R12—pot, 50,000 ohms, 2 watts, log taper
R13—2,700 ohms, 2 watts
R14, 15, 16—6 watts, 120 volts, candelabra lamps
C1, 2—0.25 μf, 200 volts
C3—100 μf, 350 volts
C4—40 μf, 350 volts
C5—10-10-10 μf, 250 volts, electrolytic
C6—1 μf, 400 volts
J1, 2—3-way binding posts
S—dpst slide
T—power transformer: primary, 117 volts; secondary, 460 volts, 50 ma; 6.3 volts, 2.5 amps (Stancor PC-8418 or equivalent)
V1—6BH6
V2—6AQ5
V3—6C4
V4—6X5-GT
Case, 4 x 5 x 6 inches
Chassis, 1½ x 4⅞ x 5¾
Lamp sockets, candelabra (3)
Pilot-light assembly with No. 47 bulb
Miscellaneous hardware

Fig. 1.—Circuit of the low frequency oscillator. Maximum output varies from 30 volts P-P on no load to 2 volts P-P into 52 ohms.

COLLARO

A.C. 4/554

FOUR SPEED

RIM DRIVE GRAMOPHONE UNITS

Installed by Australia's leading Radiogram Manufacturers

FOUR SPEED DRIVE. An entirely new type of 4-speed mechanism has been designed to give absolutely uniform turntable speed, while improved technique in the construction and assembly of the motor ensures reproduction free from rumble and frequency modulation. The drive from a 4-stepped pulley on the motor spindle is transmitted to the rim of a deep and heavy turntable through the medium of a single large diameter moulded rubber idler wheel, running on a long self-oiling bearing of small diameter to give lateral stability with minimum frictional drag. The periphery of this wheel is ground concentric to its bearing with very close limits. The idler wheel spindle, of hardened and ground carbon steel, is carried on a pair of diecast elbow levers mounted on ground steel pins with an effective bearing length of 1½ inches. The change speed control knob has a very light movement, and operates a unique cam action which retracts the idler pulley to a position clear of both the turntable and the motor-pulley whilst changing its level to engage with one or other of the 4 steps of the motor-pulley. In this way all possibility of damage is avoided should the change-speed control be operated while the machine is running. The idler wheel mounting brackets and the change-speed mechanism are built as a rigid unit integral with the motor suspension frame.

MOTOR. The motor is supplied for A.C. mains 200–250 or 100–125 volts operation. Standard motor pulleys for a frequency of 50 c.p.s. are normally fitted. Special pulleys are necessary for other frequencies, and are available on request within the range of 40 to 60 c.p.s.

AUTOMATIC STOP AND START. The stop is fully automatic and is independent of record size or length of playing surface. It is operated by the run-off groove, irrespective of its position. The starting is controlled by a movement of the Pickup Arm in an anti-clockwise direction.

TURNTABLE. This is a heavy steel rubber covering turntable fitted with a striker for operating the Automatic Stop. The turntable is fitted with a manganese bronze bearing which runs on a hardened, ground and lapped steel shaft. The thrust is taken up by a single steel ball located in the top of the bearing.

UNIT PLATE. This is a conveniently sized beaded-edge unit plate upon which all components, except the pickup rest, are mounted.

SPRING SUSPENSION. All units have three point spring suspensions and check springs, thus eliminating acoustic feed back.

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5285

ANALYSIS SHOWS WHY TYPICAL RECEIVERS FAIL

A careful analysis of repairs carried out on 600 sound receivers has revealed some interesting and rather surprising facts and figures. The sets under review comprised a wide variety of models of 55 different well-known makes—British, American and Continental.

By W. OLIVER*

POSSIBLY the most surprising thing about these findings is the small number of different faults encountered. Of the many things which can go wrong in theory, only a few seem to give trouble in actual practice; these comparatively few faults occur and recur over and over again.

This striking discrepancy between theory and practice probably explains why a practical service engineer with a long experience of repairing commercial receivers can often put his finger on a fault with almost magical speed, whereas another class of radio technician whose knowledge is mainly theoretical will be liable to muddle about for hours, testing this and that, before he is able finally to locate the fault.

EXPERIENCE, THEORY

A little learning may be a dangerous thing, but too much book-learning and too little practical experience is certainly a great handicap in quick fault-finding.

Of the 600 sets under review, nearly one-third (190 to be precise) needed one or more new valves to restore them to reasonably good working order. For optimum results, this number could easily have been doubled, but in most cases the customers would not have stood for the extra expense and therefore replacements had to be restricted to those that were really essential.

The number of valves that really had to be replaced totalled 228. Frequency-changers outnumbered any other single type, with 79 replacements. Next came output valves with 51, then rectifiers with 40, r.f. pentodes (chiefly in the i.f. stages) with 34, double-diode triodes with 17 and all other types with a total of seven.

This last figure is a bit misleading, because the majority of the 600 sets repaired were of pre-VHF/FM vintage. When these latest models become aged and need valve replacements in a big way, the proportion of double triodes and triple-diode triodes will undoubtedly be very much larger than in the present analysis.

The next biggest item on the replacement list is the fixed capacitor. In the 600 sets, 103 fixed capacitors simply had to be replaced. Here again, had expense been quite an immaterial consideration and efficiency the only criterion, one could easily have doubled this number.

Electrolytics had to be replaced in 63 cases, and as a large proportion of these were multiple units (comprising, say, 8 plus 8 plus 32uF), the total number of individual capacitors involved would be perhaps double this figure. It therefore far outnumbers all other types put together, which total 40 all told.

VARIABLE RESISTORS

Variable resistors come next on the list. Of 61 that were faulty, 57 were volume controls and only four were tone controls. Three out of the four last-mentioned were in sets which had the on-off switch ganged with the tone control. The conclusion which can be drawn from this is that the average listener readjusts the tone control very little, unless it is combined with the on-off switch and therefore has to be readjusted every time the set is switched on.

Nearly all the volume controls replaced were of the switched type; where the on-off switch was separate from the volume control the last-mentioned seldom appeared in the replacement list.

Trouble with the on-off switch occurred in 26 sets; but, in addition, some of the cases listed under faulty volume control really came under the faulty switch category, as they comprised volume controls which were changed because the on-off switch attached to them was faulty as well.

Realignment, sometimes of RF circuits only, sometimes IF only and often of both, was needed in 55 cases. A large proportion of the sets involved were small personal portables, and no doubt vibration in carrying the sets around was largely responsible.

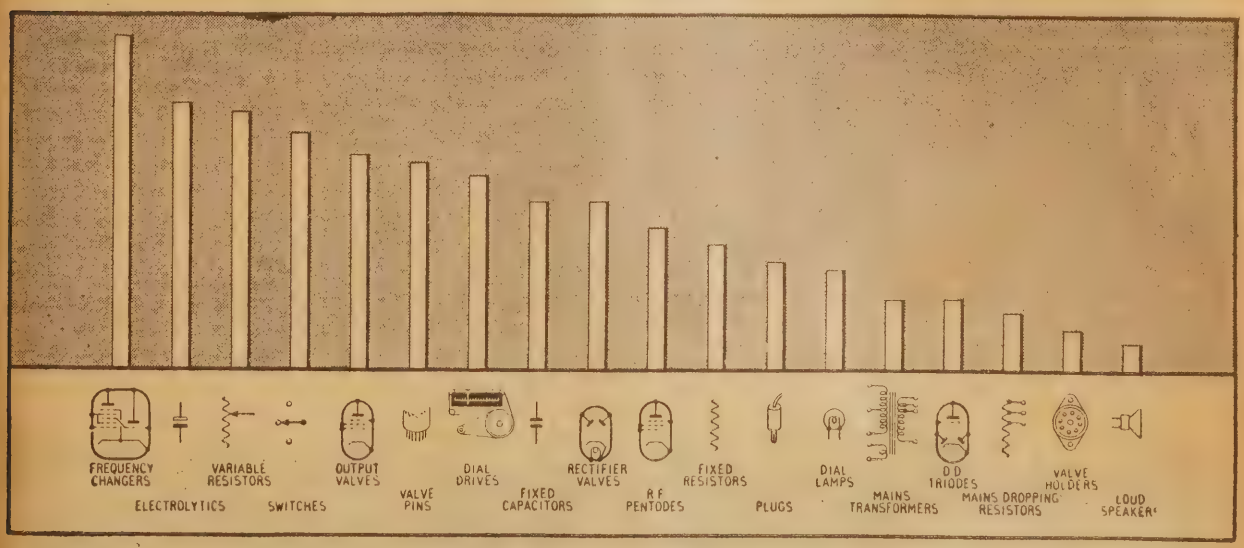
ALIGNMENT PROBLEM

One very popular model was found to be especially prone to getting right out of alignment through the iron-dust cores of the IF transformers gradually screwing themselves downwards. Sealing the cores with wax effected a more or less permanent cure in every case.

Another older type of portable frequently showed serious misalignment of the compression-type trimmers in the RF circuits. Quite half the sets of this particular type which came in for checking were found to suffer from this defect. Here again proper sealing after readjustment effected a lasting remedy.

Valve pins were the next biggest headache. Octal valves very seldom gave any trouble in this respect, owing to the large surface-area of the pins contributing to good and lasting low-resistance contact. Unless the associated valve-holders were of poor design or bad quality, this type

* *From "WIRELESS WORLD"*



In this diagram the heights of the columns are proportional to the number of breakdowns due to components listed by the author. It gives some guide to the relative probabilities with which the components can be expected to give trouble in sound broadcast receivers.

★ CRYSTAL MICROPHONES
★ MICROPHONE INSERTS

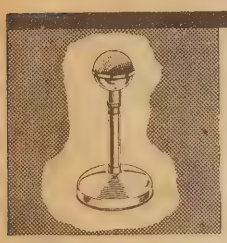


TABLE or STAND MICROPHONE MIC22

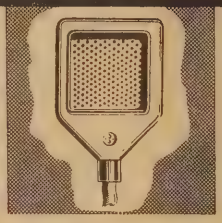
This omni - directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low-frequency wind noise will not affect the performance. An adaptor (floor mounting) is available at low extra cost.

PRICE £9/18/6.

CRYSTAL MICROPHONE MIC40

The MIC40 has been pleasantly styled in a variety of two-tone colours to give a handsome quality Microphone of modest dimensions and unassuming price. Ideal for tape recorders with a minimum of stowage space available, and a wide range of domestic applications.

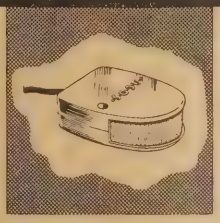
PRICE £3/19/6.



LAPEL MICROPHONE MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded-rubber case which gives protection against shock it is provided with a pin at the rear of the case for pinning to the lapel.

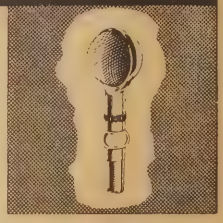
PRICE £5/19/6



GENERAL PURPOSE, MIC35

The MIC35 is housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s.

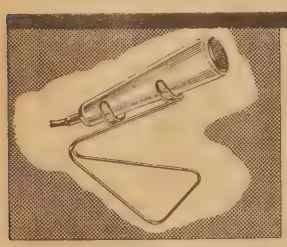
PRICE £2/15/-



HIGH-QUALITY MICROPHONE, MIC16

Incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock, and the fidelity is not impaired by low-frequency noise.

PRICE £24/19/6.

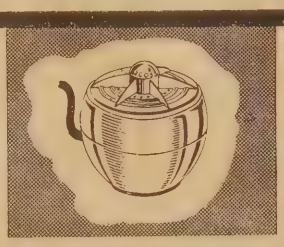


CRYSTAL STICK MICROPHONE, MIC39-1

The MIC39-1 has been beautifully styled as a hand, desk stand or floor stand unit, and precision engineered to the highest professional standards.

A heavy die-cast liner in the microphone case eliminates the possibility of hum pick-up due to hand capacity effects. The use of a special noise-free cable improves screening and gives a greatly increased signal-to-noise ratio.

Designed especially for high quality recording, broadcasting and public address work. PRICE £8/19/6, complete with desk stand.



HAND or DESK MICROPHONE, MIC33

Has been designed for the public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case. Unaffected by vibration, shock or low-frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s.

PRICE £6/16/6

CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as 15/16 in. square to 1 13/16 in. round, with various thicknesses from 7/12 in. to 9/16 in., Suitable for every purpose, such as hearing aids, public address, tape recordings, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at —5 db to —30 db. Insert can be supplied with or without 10 meg. resistor as required. MIC19/4 and MIC32. £2/15/6; all others £1/19/6.

DESK or HAND MICROPHONE, MIC36

Ideal for home recording, public address, etc. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost.

PRICE £6/18/6.

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of valve usually maintained satisfactory contact almost indefinitely.

But the modern miniatures, with their very slender pins, seem to be more susceptible to contact troubles. In fact, in 49 cases defective contact was found to be causing loud "scratching" noises or poor signal strength or even complete failure.

Admittedly the fault was often partly due to the design of the valveholder: types with contacts which exerted a really firm grip on the valve-pins were generally found to be trouble-free.

Defective fixed resistors of various kinds accounted for 47 faults. Of these, 14 occurred in mains-dropping resistors, three in line cords, and 30 in other fixed resistors, mostly of the miniature type and usually through overheating due to excessive current passing through a broken-down bypass capacitor connected between the resistor and the chassis

DIAL CORDS

Next on the list, accounting for 46 jobs, were repairs to drive cords and dial-drive mechanisms of one kind or another. A good many of the drive-cord breakages were due to excessive pulling on the cord occasioned by neglect of lubrication on pulleys and other moving parts

In many cases the life of the drive cords would have been lengthened almost indefinitely by regular attention to lubrication of pulleys, etc.

Switch faults totalled 56; 30 of these were in wave-change switches and 26 (as already mentioned) in on-off switches. In some sets wave-change and on-off were combined, so the figures are somewhat elastic in this case as the faults were difficult to classify

Battery plugs, spade tags and mains plugs caused 26 faults, of which 20 occurred in battery-powered sets. Dial lamps failing caused a number of breakdowns in cases where they were in series with valve heaters The total number of such cases amounted to 24 in all. Dry joints in the wiring caused 21 breakdowns.

One particular make of set seemed particularly unlucky in this respect. Evidently some of the soldering in that factory was—in more than one sense—none too hot!

MAINS TRANSFORMERS

Mains transformers accounted for 17 failures. Some of these could have been prevented by more timely servicing of rectifier valves, smoothing capacitors and so on. Others would have caused less expensive damage if the manufacturers of the sets had incorporated one or two suitable fuses.

Only in two or three instances were the failures due to actual internal breakdown in the transformers themselves.

Mains leads had to be replaced in 13 instances, and 10 new valveholders had to be fitted (an average of only one in every 60 sets). Metal rectifiers had to be replaced in 10 sets, but this figure is a little misleading as a good many had to be fitted in pairs.

Eight frame aerial leads had to be renewed in portable receivers which had the frame aerial windings in the hinged cabinet lid. Opening and closing of the lid caused the breakage of the flexible leads through continual bending.

Other components replaced or repaired included five loudspeakers, four trimmers, four IF transformers, two tuning capacitors and two loudspeaker field coils.

ELECTRONICS IN LATEST CARS

Operator observes plug-in panel which checks engine performance of GM's Firebird III as the U.S. auto industry ponders the problem of electronic devices for its new products. Will they maintain the status quo, seek greater simplicity or fill the new cars with a costly array of electronic gadgetry?

Detroit is making studies to find ways of using electronics to steer, control and protect the future's mass market auto. There are still some bumps in the road but the light is green, according to a recent "Electronics" Business Issue.

ANNOUNCEMENTS during October of 1959 auto models draw attention to the growing potential of electronics in the American automobile.

Besides the radio and the increasingly more common headlight dimmer found in the present car, planners are thinking about new electronic applications for vehicle steering controls, radar warning systems, electroluminescent interior lighting, and electronic ignition systems.

Case in point is General Motors gas turbine car, Firebird III (photo) unveiled recently. It has an electronic speedometer, tachometer, fuel gauge and steering controls. It uses more than two miles of electrical wiring, includes two AC generators driven by a separate accessory drive engine.

Spokesmen for the experimental car point out, however, that these, as well as other electronic accessories in the Firebird III, are still in the demonstration phase, and have been built into the vehicle primarily to show that certain mechanical functions can be performed electronically.

AC GENERATORS

In spite of this, certain of the "blue sky" aspects of the car will be finding their way into production autos. Already some Detroit spokesmen are talking frequently of AC generators. They have been successfully used in trucks and marine engines.

As increased use is made of AC generators, the use of rectifiers to convert AC to DC is said to be certain to follow. One manufacturer, whose present sales of semi-conductors to the auto industry, is limited mainly to auto radios, says engine temperature effects on rectifier operation are already being studied by his firm.

Further increase of semi-conductors sales is seen as transistors become increasingly important to car radios. Most of next year's radio models will contain at least one power transistor.

One firm supplying auto manufacturers as well as retail car radio stores says it will add an additional driver transistor to new models in about 50 per cent of its output.

SIX MILLION RECEIVERS

Twenty years ago, according to Electronic Industries' Association, 800,000 car radios were sold. Last year's sales totalled 5,496,000. Predictions for next year range between five and six million. This estimate is for radios sold directly to manufacturers for installation in new cars at the factory. An anticipated one million more will be sold to retailers.

There is little talk in radio circles of any great production or sales endeavours for f-m, hi-fi, or stereophonic car radios.

Another here-and-now development in electronics for autos is a device which automatically changes the angle of the rear view mirror to reduce glare from following headlights. A second light-sensitive unit dims headlights, in response to oncoming vehicles. It also does the same thing in response to tail lights of vehicles being followed.

The headlight dimmer, which uses transistors and miniaturised circuits, will be installed as optional equipment in five 1959 auto lines.

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NEWS AND VIEWS OF THE MONTH

Flexible barges

THE first operational "dracone," a flexible barge, which takes its name from the Greek word for serpent, recently underwent tests at Southampton. This new British invention is designed to transport liquids such as petroleum, liquid chemicals and other oils by sea. Measuring five feet in diameter and one hundred feet in length, one model carried over ten thousand gallons of kerosene, weighing some forty tons.

The vessel is made of woven nylon fabric covered on both sides with synthetic rubber, which is resistant to petrol, oil and sea water. The small vessel is a preliminary step to flexible barges of very much greater capacity and vessels between 200 and 300 feet in length capable of carrying up to 270,000 gallons are on the drawing boards.

A number of advantages are claimed for the dracone: it has considerable resilience—for instance it can be collided with and not break open and will ride the roughest seas; a flexible barge carrying a thousand tons of oil would cost about £10,000, which is very much cheaper than a ship of the same tonnage, and it's quite conceivable that a relatively small ship could tow a number of them to form a raft in much the same way as a tug tows barges. But one of its greatest advantages is that after its cargo has been pumped out into a tanker or storage depot it can be rolled up like a garden hose and lifted aboard a ship or lorry for transport back to the supply point.

★ ★ ★

Fuel from space

THE U.S. Air Force is working on a missile designed to fly on fuel scooped from the atmosphere.

The Air Force released a report in Washington giving detailed results of research in 1957 into the feasibility of such a missile.

It said the missile would be propelled by atomic oxygen.

Called the Hare, the missile would fly at about 900 miles an hour at an altitude of about 60 miles.

Its fuel would be oxygen broken down by ultra-violet radiation.

The normal oxygen molecule consists of two atoms.

When separated they have a powerful urge to recombine into molecular form with a great release of energy.

★ ★ ★

TV headquarters

THE B.B.C.'s new Television Centre, when completed in 1960-61, will be the largest television headquarters in Europe. Standing on a site of 13 acres, it will consist of a vast main block containing seven studios and several hundred offices; a scenery block; a restaurant block; a works block; and eventually a "spur" or "tail" running from the main block. Estimated cost, £9,000,000 sterling. Four studios are expected to be in operation in 1961.

Export of reactor

THE first licence for export of a U.S. manufactured power reactor has been issued by the Atomic Energy Commission.

The licence, dated November 6, 1958, authorised shipment of the reactor to Belgium for installation at the nuclear development centre at Mol, about 30 miles east of Antwerp.

The facility to be shipped is a pressurised water reactor, cooled, moderated and reflected by ordinary water. It is being manufactured by Westinghouse Electric Company. The reactor, fuelled by uranium with a maximum enrichment of 4.43 per cent U-235, will have a thermal power output of 43,000 kilowatts and will produce 11,500 kilowatts of electricity for feeding into the Belgian electrical system through the switching station at the Mol steam plant.

Westinghouse is now running experiments on the reactor core at the Company's Reactor Evaluation Centre in West Moreland County, Pa. Work on the foundation, containment vessel and turbine generator, is well under way at Mol.

It is expected that the reactor vessel will be shipped from New York within the next few weeks, and that other components will be exported over a period ending June 30, 1960. All major components are expected to be shiped by March, 1959.

POPULAR SCIENCE QUIZ

Q: What is Brownian movement?

A: Brownian movement is the continuous agitation of the particles in a colloidal solution caused by unbalanced impacts with molecules of the surrounding medium The motions of the particles may be watched with a microscope if a strong beam of light is passed through the colloidal solution at right angles to the line of sight

Q: We often hear of people's voices being raised to concert pitch. However does concert pitch have any real meaning?

A: Yes. Concert pitch is the recognised pitch to which musical instruments are tuned if they are to be played together. The exact value has varied throughout the ages but has more recently been standardised so that A (the one above middle C) is 440 cycles per second.

Q: What is the Doppler effect?

A: When a source of sound is moving away from the point of observation, its frequency appears to be lower than it actually is and when the source is moving toward the observer, it appears to be of a higher frequency. The change in note when a train whistle or the horn of a fast moving car passes an observer can often be noticed.

The effect can be used to measure the speed of objects on the ground and also the velocity of stars moving about the universe, the latter because the effect applies to light and radio waves as well as sound waves.

Q: What are some of the significant facts about oxygen?

A: Oxygen is a colourless, odourless gas which supports combustion and is essential to most forms of life. Oxygen is the most abundant element, forming 21 per cent by volume of the atmosphere. 89 per cent by weight of water and nearly 50 per cent by weight of the rocks on the earth's crust.

It is manufactured from liquid air for use in welding apparatus, medical practice and more recently for the propulsion of space rockets. Mixed with charcoal, sawdust, etc., it forms a powerful explosive.

Q: What is the difference between steel and iron?

A: Steel is essentially an alloy between iron and carbon and the mechanical properties of the steel can be varied over wide limits by varying the carbon content. Most steels contain less than 2 per cent of carbon, although other elements and heat treatment are also used to obtain the desired properties for a particular application. For electrical applications, for example, silicon is frequently added to reduce power losses due to hysteresis.

Q Fluorescent lamps are frequently used nowadays. Why are they so called?

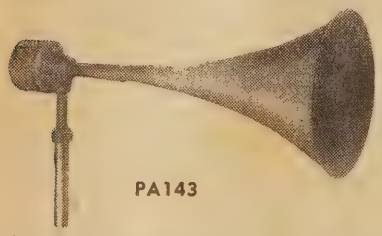
A: A substance is said to be fluorescent when it absorbs radiation of a particular wavelength and re-emits it as light of a longer wavelength. In the case of the fluorescent lamp, ultra-violet light is generated by the electrical discharge. This excites the fluorescent material which emits visible light. The characteristic of the visible light depends on the material and many different types of light can be obtained.

Sound Distribution SPEAKERS

AWA manufacture the most complete range of speaker assemblies—there's a unit for every sound reinforcement need. AWA designs these speakers for maximum faithfulness in sound reproduction. Styles and finishes are available from stock or designed for individual use and circumstance.

PA138

Standard reflex horn speaker for medium distance projection of speech and incidental music.



PA143

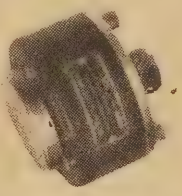
Short exponential horn speaker for distance projection of speech only.

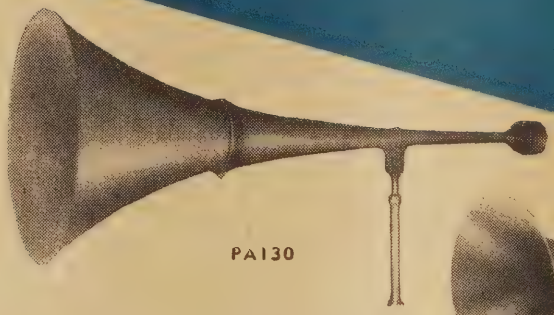
Ivory timber cabinet with 7in. speaker for applications where a bi-directional characteristic is desired.

PA73

RESLO DRIVE UNITS: SU10 & SU12

Exclusive features are the self-locating diaphragm and the concentrically interlocked magnet which together produce an undisplaceable mechanical assembly, proof against decentering.

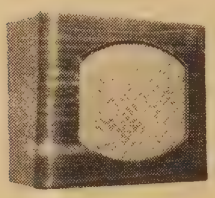




PA130

PA108 & PA109

Standard exponential horn speaker for public address where distance projection of speech and incidental music is required.
These flare baffles are for use with 7in and 12in permanent magnet cone speaker units and provide high conversion efficiency



PA77/12PS

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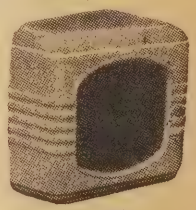
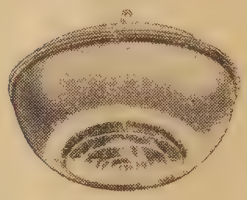
PA150/1

Attractive moulded cabinet with 7" cone speaker and 600 ohm line transformer Suitable for wall or desk mounting. In grey ivory and walnut



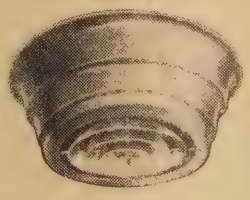
PA343

General purpose line source reproducer for music and speech range 100 to 7,000 cycles. Power capability 15 watts of programme



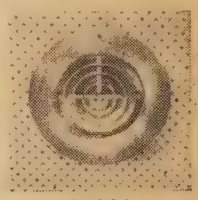
PA218

Designed for overhead mounting in contemporary styling The unit can be suspended by chain or rod. Gives uniform response over a wide area



PA188

For overhead mounting this is a surface style unit 360 degree diffusion over a wide area In smart styling to suit modern architectural treatments



PA186

For flush mounting, this unit has a recessed acoustic surround which mounts the complete assembly above the ceiling line. 360 degree diffusion.

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Radio-active signal

A RADIO-ACTIVE powered switch signal has been installed by the Pennsylvania Railroad.

The signal will stay illuminated for 10 years without being refueled.

It measures about a foot square and weighs 44lb.

The company said that, except for an occasional cleaning to remove dust from the red and green lenses, the unit should not need further attention until 1969.

If test proves successful, the railroad said, the light eventually may replace all present paraffin and electric signal switch lights in its system.

★ ★ ★

Novel rescue dinghy

AIR-SEA rescue work in Darwin, Lae (New Guinea), Hobart and Adelaide, has been taken over by amazing Zodiac dinghies.

Department of Civil Aviation officers are amazed at the versatility of the craft.

The Zodiac is a collapsible boat made of rubberised fabric and timber.

Those in use carry a crew of two men and five other 10-man dinghies.

In all, the crew of two could rescue 100 persons — 60 in the six dinghies and 40 hanging on in the water.

The Zodiac is powered with an 18 h.p. outboard motor and is capable of 20 knots.

At Darwin, for example, a Zodiac has replaced two R.A.A.F. rescue launches.

The Zodiac is faster, can carry a greater number of persons, and is very stable and seaworthy, even in rough seas.

At Darwin the Zodiac is located close to the aerodrome and maintained partly inflated on a trailer which is hauled by a four-wheel drive vehicle.

It is operated by the aerodrome fire-fighting service and can be launched within 10 minutes.

A D.C.A. official said that when the Zodiac was demonstrated in Darwin, officials were amazed by its performance.

It crossed Darwin harbour and returned in 20 minutes.

★ ★ ★

Nuclear-powered plane

AVIATION WEEK magazine's report that Russia was flying a nuclear-powered plane brought immediate reaction.

The United States had been doing development work on an atomic-powered plane for 13 years.

But the rate of progress had been held back by erratic financing of the project.

Aviation Week said the Russian plane had been flying for about two months.

It said the plane was 195ft long, had a wing span of 78ft and weighed 150 tons.

Defence officials said they had no doubts that Russia had flown or soon would fly a nuclear-powered plane.

The New York "Times" quoted an unidentified expert source as being sceptical of the magazine article because of the reported position of the nuclear engines — hung in pods on each wing.

The expert said that the nuclear engines would be extremely heavy and more logically should be mounted in the fuselage.

The United States first used a nuclear reactor to provide heat to power a jet engine in January, 1956.

Forty-seven flights have been made by a B-36 bomber with a 1000-watt reactor aboard. But the heat has never been harnessed to any propulsion machinery.

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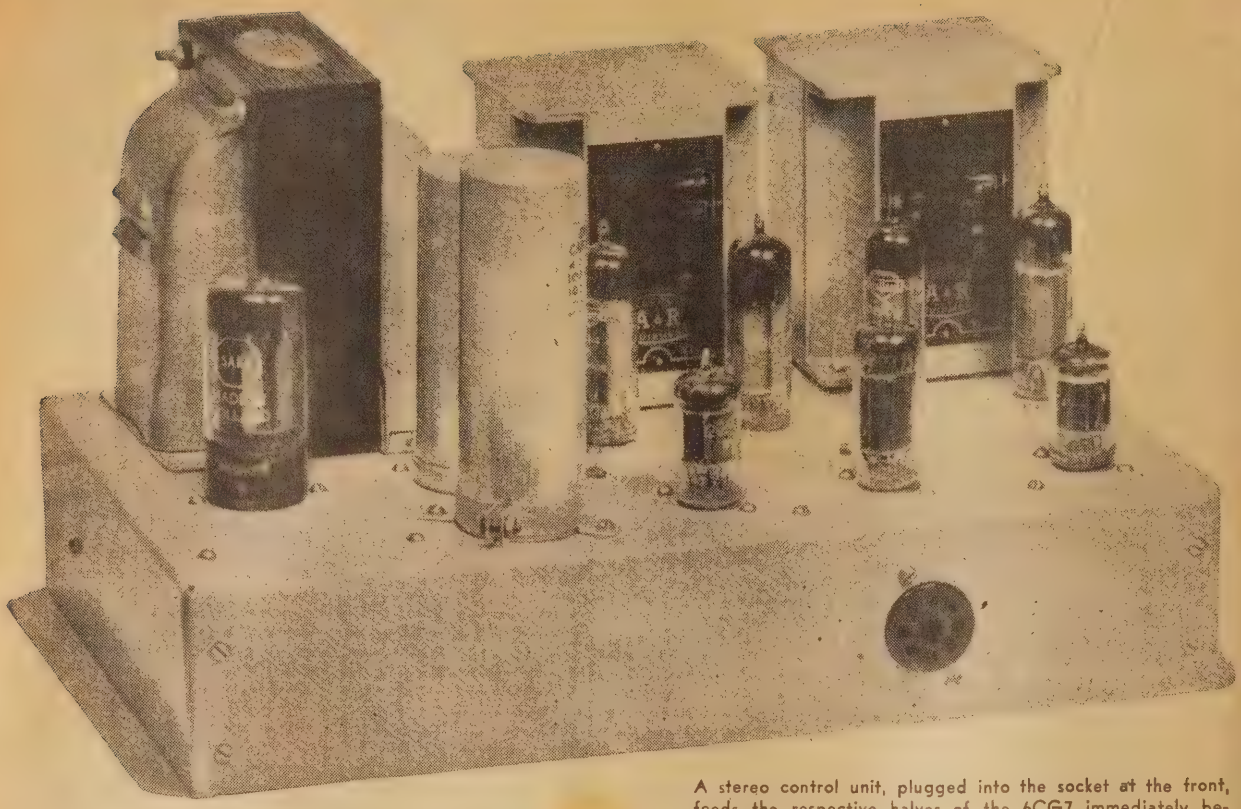


A stereo control unit, plugged into the socket at the front, feeds the respective halves of the 6CG7 immediately behind and thence into the two valve groups seen to either side.

A Twin Ten-Watt Amplifier For Stereo

Here is an amplifier which may well become the "standard" unit for high quality, domestic stereo listening. With superb characteristics itself, the amplifier can be used immediately with a stereo Control Unit to suit crystal or ceramic pickups or, later, with the more elaborate Control Units which will have to be devised for high quality magnetic types.

by John Moyle

NOW that the stereo position is settling down we can begin to consider some standard equipment for use with it. So far we have produced a twin single-ended amplifier, self-contained, for crystal pickups, and it has proved to be extremely successful. Nothing associated with the design suggests there is need to modify it in any way.

We have also described a control unit for crystal pickups intended for use with a pair of Playmaster amplifiers, and again this unit has operated well.

The next step is to think about a really high-quality design and suitable for use with high-grade speakers and giving the highest standard of reproduction.

Experience in listening seems to indicate that two 10-watt amplifiers will give enough output to fill a small hall with ease with efficient speaker units, and in all but special cases will be adequate for home use.

Just as there are always customers for really high-powered amplifiers of 20 or 30 watts, undoubtedly there will be some who will not be happy until they can command a couple of channels of this power. These people are entitled to their ideas, and we will probably work out a suitable amplifier at some time in the future.

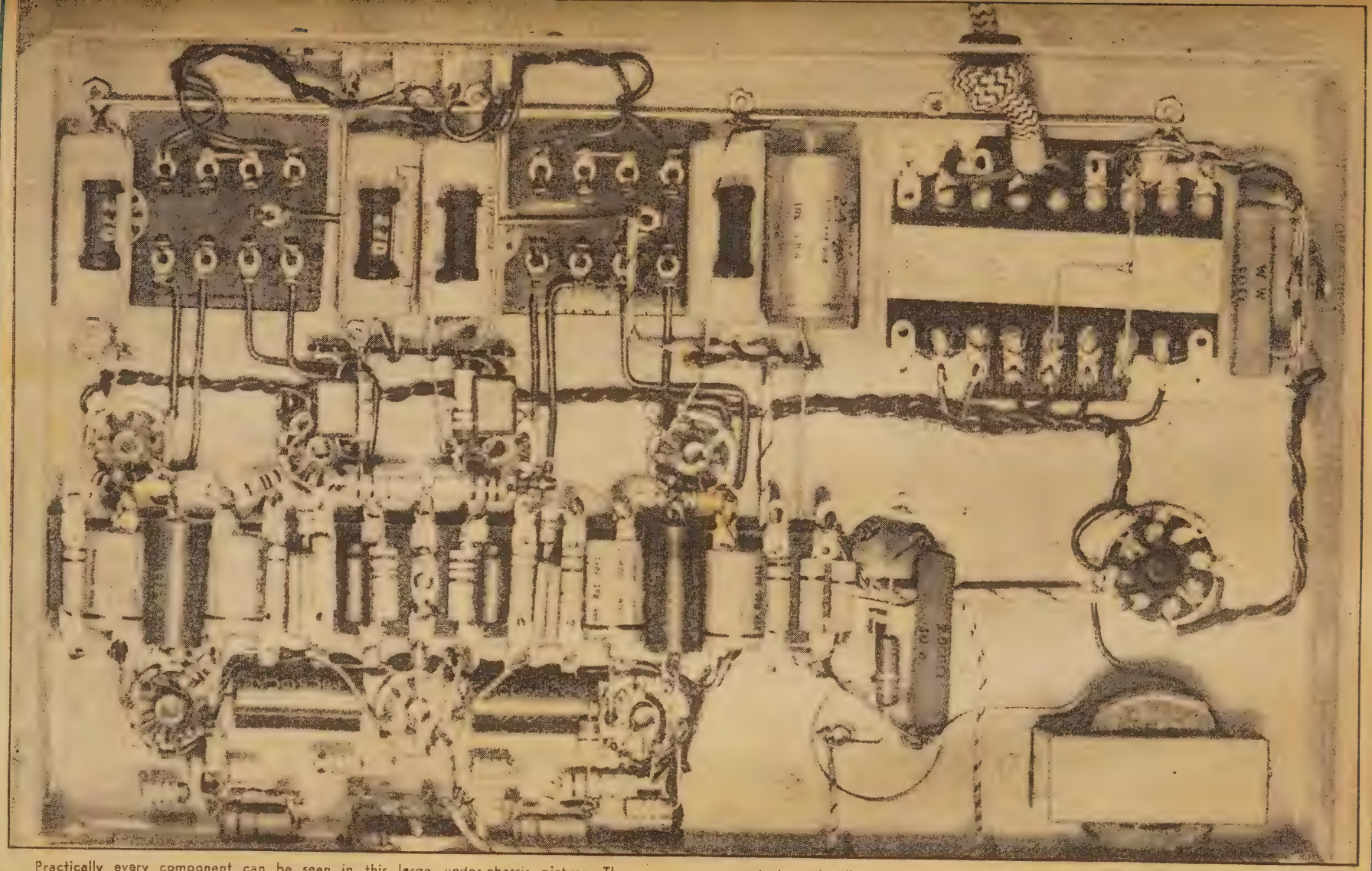
An amplifier of this size will be very large, heavy and costly, for its power supply alone will probably need to give at least 300 mills and voltages up to 400 volts.

Most people would want to be very sure of their needs before building such a mammoth.

The twin 10-watt amplifier is a much more modest proposition, and because most of the time both channels will be producing a goodly proportion of the output, we must think of its power potential as being substantially 20 watts.

An attractive feature of such an amplifier is that the voltage output at the rectifier need not be more than about 325 volts, and this means that we can adopt the high-filter-capacitance technique which greatly simplifies high-tension smoothing. For voltages higher than this we are forced to use higher voltage ratings, which complicates the task.

It is probable that the high-quality



Practically every component can be seen in this large under-chassis picture. The power supply is seen near the top, with the rectifier series resistors mounted on a tagstrip attached to the side of the chassis. Signal from the Control Unit passes to the 6CG7 and then divides to the remaining valves on either side. Wiring of the two amplifiers is symmetrical, with all active leads kept very short. The layout of components on the tagstrip is shown on a diagram elsewhere in the article. Note that all four output valves have separate bias resisto s but common resistors can be used, if desired. The amplifier is intended to be used with a separate Control Unit.

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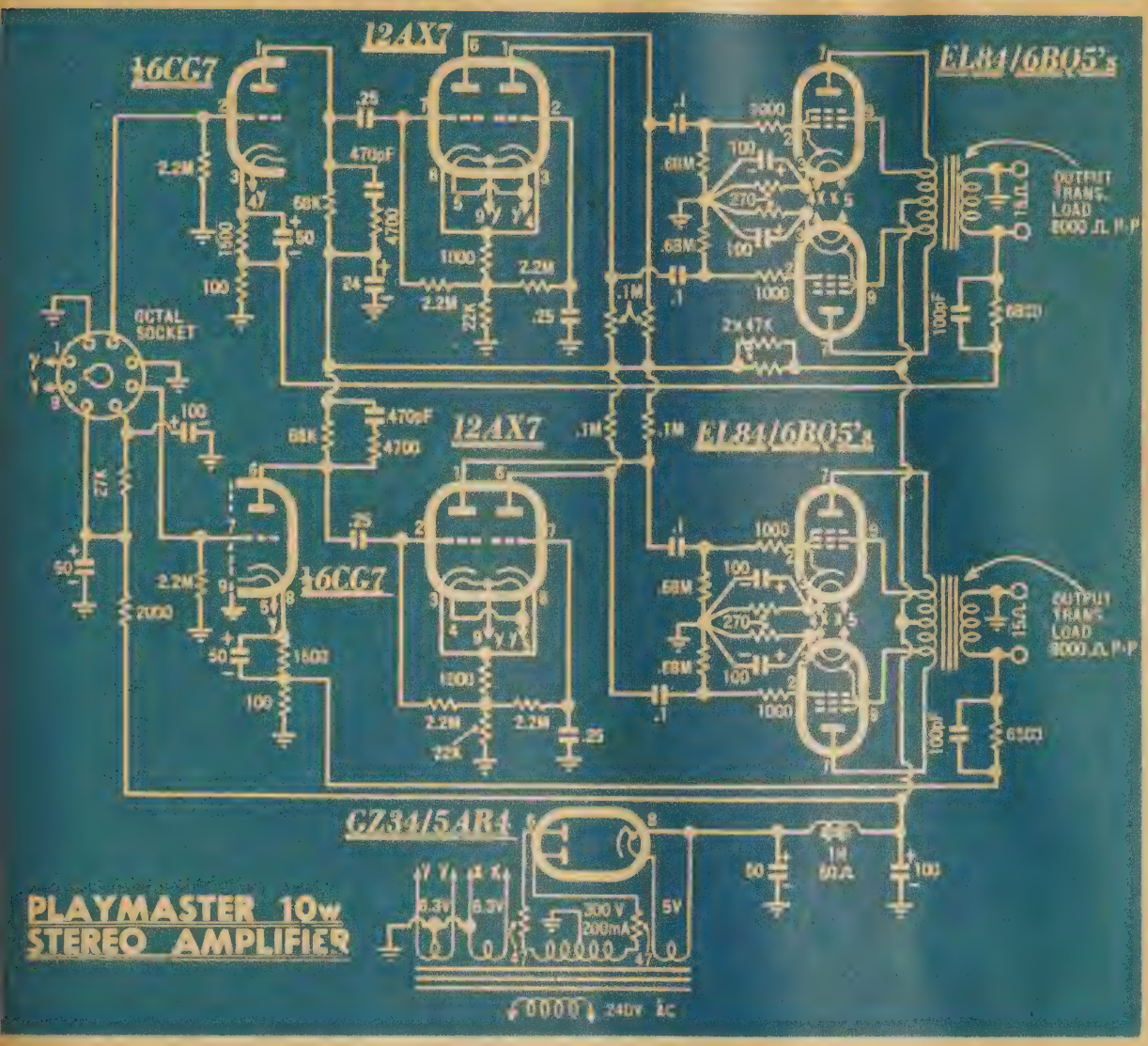

With a total power output from the two channels of twenty watts, this new amplifier is ample for high quality domestic listening. The two channels operate from a common power supply.

10-watt dual-channel amplifier will become a standard item in the hi-fi repertoire, and it would be safe to say that most manufacturers will regard it as a "must" in their list of models.

In considering the design, the problem is virtually a double statement of the factors which have already influenced the design of single channels.

There is no particular reason why circuits which have proved so good in the past should need much modification in their essentials for stereo. In this instance we are influenced not primarily by lowering the cost, but in getting the best possible results.

For instance, it is not hard to visualise a neat little amplifier using valves such as the 6BM8, in which we could economise on the number of valves and components.

No doubt we shall describe such an amplifier later on, but it would not really be a competitor of this one. It is probable that we would have to make some compromises, and even abandon an ultra-linear connection to preserve reasonable output and avoid circuit difficulties.

But in the 10-watt field the same general configuration used in the 17-watt amplifier looks to be the best, and the EL84 output valves have proved very successful in this circuit.

COMMON SUPPLY

Obviously, it would not be economical to make two entirely separate amplifiers and power supplies and mount them on a single chassis. The power supply, in particular, can be made common to both sections and some other circuit functions combined to save components.

Let us now have a look at the amplifier circuit itself and see how it has been tailored to these requirements.

In general, each channel has a voltage amplifier, a phase-changer, two output valves and output transformer, with a feedback loop taken from the output transformer secondary to the cathode circuit of the voltage amplifier.

It has been our custom with the Playmasters to use an input sensitivity of about 200 millivolts for full output so that the various control units we have described from time to time can be interchanged with any of them.

If these units are to be co-ordinated, it is necessary to avoid large differences in input requirements between amplifiers.

This circuit has slightly higher overall gain than most of the previous amplifiers, largely because of the extra sensitivity of the EL84s, which need only about half the voltage drive required for the larger EL37s. In practice, 180 millivolts will produce an output of approximately 10 watts.

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nection of probable control units, although it could be increased if necessary by using a little more feedback.

However, we have specified feedback of 20-22db, which we have found the best all-round figure for good results and maximum stability.

The only real change in the circuit from our standard practice lies in the choice of the voltage amplifier.

Normally, we use an EF86 as a triode, mainly because it operates very well in this service, and there is no comparable single triode to take its place.

Because we now have dual amplifiers, we require two voltage amplifying triodes, and the logical procedure is to use a twin type, one half connected to each amplifier.

EXCESSIVE GAIN

The 12AX7 is a possibility here, but because its gain is much higher than that of the EF86 we would end up with an input sensitivity much greater than we require.

High amplifier gain, particularly when coupled to a control unit where further gain is added after the volume control, almost certainly leads to noticeable valve hiss level, even when the gain control is at zero.

When speakers having a rise in the middle register response are used, some readers have found this hiss annoying, even with our standard designs.

We could reduce sensitivity by adding more feedback, but it would need to be in the region of 30db to be effective, and this is always risky without careful amplifier adjustment.

As a matter of interest, the amplifier will operate satisfactorily with a 12AX7, and we have measured up to 32db of feedback using it.

But we prefer a solution in which a lower gain twin triode is used, such as the 12AU7, or, better still, the new 6CG7.

This valve is almost directly equivalent electrically to the 6SN7, but has a 9-pin base and a shield plate internally mounted between the two triode sections.

The socket connections differ from the 12AU7 in that pins 4 and 5 are used for filament with 6.3 volts. Pin 9, which, with the 12AU7 and similar valves is the filament centre tap, is connected to the internal shield.

MINOR ADVANTAGES

It is problematical whether the shield between sections is important here in reducing inter-channel cross-talk, although it must be a help, but the filament connections avoid the need to run leads round the socket close to a grid pin where hum pickup could occur.

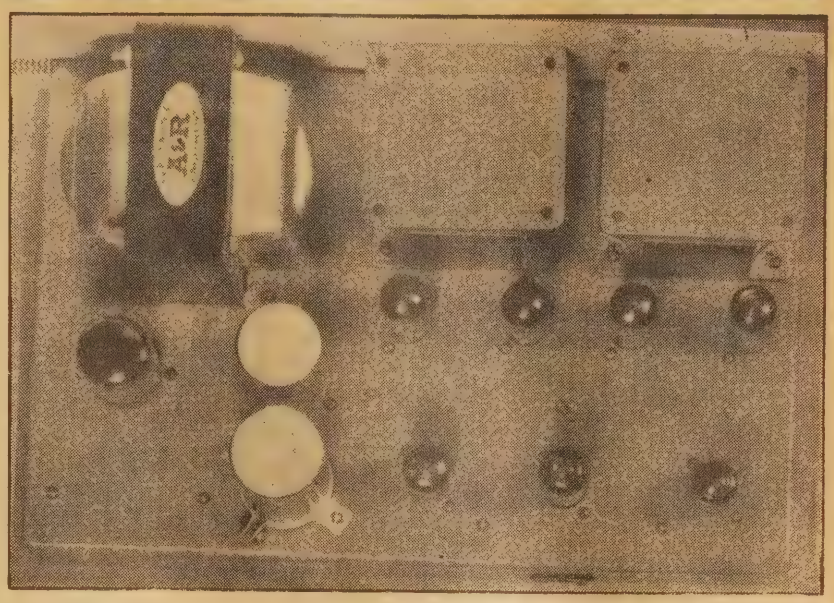
The valve is made essentially for an oscillator in TV receivers, but in general it can be considered an improved version of the 12AU7-6SN7.

The gain is a little lower than the EF86 triode, but is just about right for our purpose.

Further inspection of the circuit will show that both phase changers and the two sections of the 6CG7 use a common plate decoupling point. The low impedance of the power supply and a large decoupling capacitor at the feed point are quite successful in avoiding regeneration in this part of the circuit.

The power supply itself needs some special comment, particularly concerning the ratings of the power transformer.

TOP VIEW OF AMPLIFIER CHASSIS



As will be apparent from this picture, there is room on the chassis to accommodate transformers of different shape, to your own choosing. In particular, the power transformer will need to be slightly larger than the one shown if the amplifier is to be used with a radio tuner.

The drain of the amplifier plus a typical control unit is about 160 mills, and a transformer rated at 175 mills and 285 volts produced exactly 300 volts between the plates and cathodes of the output valves. This is the maximum voltage allowed by the makers.

If a tuner is used—and we must allow up to 30 mills here in case it is a large one—the drain will rise to about 190 mills and the output from the rectifier could drop by up to 15 volts.

Thus if we wish to use a tuner and preserve full output from the EL84s we must specify a transformer rated at 300 volts per side and a current capacity of 190 mills minimum.

The difficulty is that, should the amplifier be used without a tuner and no extra drain be provided as compensation, the voltage rating on the output valves will be exceeded and they may be damaged if operated this way over a period.

If a 285 volt 200 mill power transformer is used and a small reduction in maximum power output is acceptable this would perhaps be the best solution, if you are in the habit of disconnecting your tuner.

With the larger transformer an external load in the form of a resistor and a plug could be inserted into the receiver output socket of the control unit (10K 10 watts), and this would restore the status quo.

Alternatively the resistors in the plate leads to the rectifier could be increased in value to provide the necessary voltage

PARTS LIST

- 1 Chassis 12¾ x 8¼ x 2½.
- 1 Power transformer 300 volts at 200mA, 5 volts at 2 amps., 6.3 volts at 3 amps, 6.3 volts at 3.5 amps.
- 1 1 henry 50-ohm choke.
- 2 Output transformers U-L 8,000 ohms PP, secondary to suit speakers.
- 7 Noval sockets.
- 2 Octal sockets.

VALVES

- 1 6CG7, 2 12AX7, 4 EL84, 1 GZ34.

RESISTORS

- 4 .1 meg 1 watt resistors.
- 2 68 K 1 watt resistors.
- 2 22 K 1 watt resistors.
- 1 27 K 1 watt resistor.
- 2 47 K 1 watt resistors.
- 2 6,800 ohms 1 watt resistors.
- 2 1,500 ohms 1 watt resistors.
- 2 1,000 ohm 1 watt resistors.
- 2 100 ohm 1 watt resistors.
- 6 2.2 meg ½ watt resistors.
- 4 .68 meg ½ watt resistors.
- 2 4,700 ohms ½ watt resistors.
- 4 1,000 ohms ½ watt resistors.
- 1 2,000 ohms 5 watt resistors.
- 2 47 ohms 5 watt resistors.
- 4 270 ohms 3 watt resistors.

CAPACITORS

- 1 2 x 50 mfd 450 VP (or higher) electrolytics.
- 1 2 x 100 mfd 350 VW electrolytic.
- 1 24 mfd 350 VW electrolytic.
- 4 100 mfd 40 PV electrolytics.
- 2 50 mfd 3 volt electrolytics.
- 4 .25 mfd 400 volt (preferably Microcap).
- 4 .1 mfd 400 volt paper.
- 2 470 pF mica or ceramic.
- 2 100 pF mica or ceramic.

SUNDRIES

1 4-lug output terminal board, 1 6-lug mounting strip, 1 4-lug mounting strip, 2 3-lug mounting strips, 1 2-lug mounting strip, 8in of component board, nuts and bolts, solder lugs, tinned copper wire, spaghetti sleeving, hookup wire, 3-core flex and 3-pin power plug.

THE WARBURTON FRANKI PAGE

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	7" 1700'	3/19/6
SCOTCH	3" 200'	1/1/
No. 111A	5" 600'	2/5/
	7" 1200'	3/10/
LONG PLAY	3" 300'	1/8/
No. 150	5" 900'	3/10/
	5¾" 1275'	4/4/
	7" 1800'	5/10/
PHILIPS	3"	2/5/
LONG PLAY	7"	4/-/
E.M.I.	3" 175'	12/

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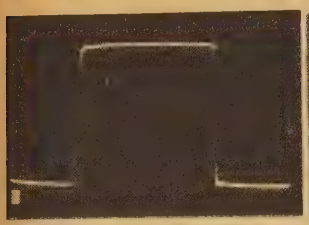
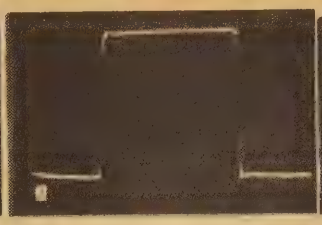
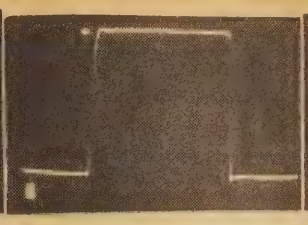


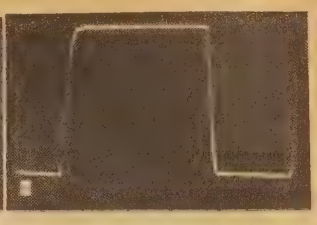
5Kc square-wave, output across 15ohm resistive load.



5Kc as before and 22db feedback. Load open circuited.

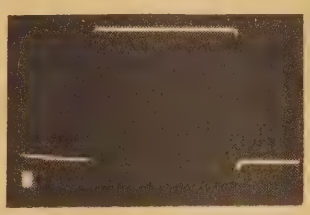


5Kc, 22db of feedback and 15-ohm speaker load.

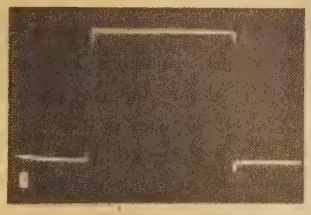


10Kc, 22db of feedback and 15-ohm speaker load.

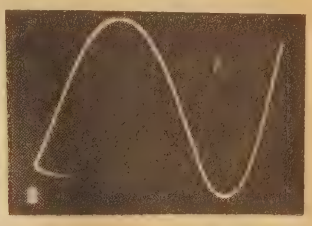
5Kc but 32db of feedback. 15-ohm resistor load.



5Kc, 32db of feedback. Load open-circuited.



5Kc, 32db of feedback. 15-ohm loudspeaker load.



50-cycle sine wave, 32db feedback, 10W into 15ohms.

drop, but this is a more awkward solution.

If the amplifier is not intended to be used with a tuner the 285 volt 175 mill transformer would be the simplest and cheapest way out.

To sum up, therefore, if used without a tuner, a 285 volt transformer rated at 175 mill looks to be the best standard type to use. With a tuner having a drain of about 25 mills, actual tests show that 300 volts per side at 200 mills will give 300 volts between the output plates and cathodes. In each case the rectifier plate resistors were of 50 ohms.

POWER SUPPLY

The power supply circuit is very similar to that used in the 17-watt amplifier except that we have used a small TV smoothing choke in place of a resistor.

Such a choke has a resistance of 25-50 ohms according to type, is quite cheap and gives slightly better smoothing that the resistor with less voltage drop.

Two double-section electrolytics were used, but if these are hard to get, as sometimes they are, the capacitance can be made up with pigtail tubulars of appropriate ratings.

We have included a step circuit in across the anode loads of the voltage amplifying triodes to increase high frequency stability, but only as a precautionary measure.

STABILITY MARGIN

As outlined in articles in November and December issues, a higher margin of stability against capacitive loads will result when these components are added, but in practice the amplifier is equally stable without them.

As a matter of interest we carried out further stability tests with each of the two channels and found a state of affairs very similar to those analysed in more detail in the issues mentioned.

The only conditions under which high frequency oscillation can be induced is when connecting a capacitor of .027-.047 directly across the load. This value of capacitance is not approached in any normal load connection, even using crossover networks and very long speaker leads.

To make an amplifier which would be absolutely stable under any artificial capacitive loading is not possible without degrading either frequency response, square wave response, or both.

As the cathode ray oscillograms published herewith clearly show, the amplifiers have excellent square wave response at 5 Kc on any load, including 16 ohms, open circuit, or loudspeaker, and there is no sign of instability of any kind. The loud speaker loud included about 30ft of plastic connecting lead.

As a further check on stability we increased the feedback to more than 30 db and repeated the square wave tests. The patterns produced were almost identical with the first set and indicate that this amplifier has a very wide margin of stability.

It is probable that results would have been the same with any of the high quality audio transformers which are or may be available, but at the time of writing we have not had the opportunity to test them all.

At no stage in any of our work was low frequency instability experienced.

Probably the main interest in this design rests in the physical layout of components.

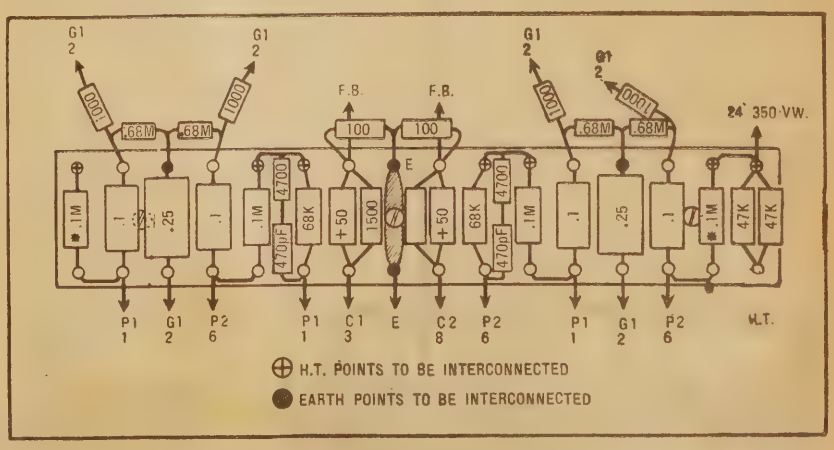
The grouping of two complete amplifiers on a reasonably sized chassis does pose some problems.

Any push-pull circuit gains from a symmetrical layout and two stereo channels should be kept as separate as possible to avoid cross talk and even feedback.

OPTIMUM LAYOUT

Our aim, therefore, was to evolve a layout in which the signal made a forward progression from input to output with no doubling back and no crossing of "hot" leads. In addition we wanted to keep the power supply and its components well away from the amplifier wiring and to allow the fullest ventilation for all valves.

The design as shown here achieves all these things and at the same time allows an orderly grouping of components, a large number of which may



Wiring details of the resistor panel. In the interests of balance, the 0.1 meg. resistors can be checked on a bridge or ohmmeter and the highest values used in the position marked with an asterisk.

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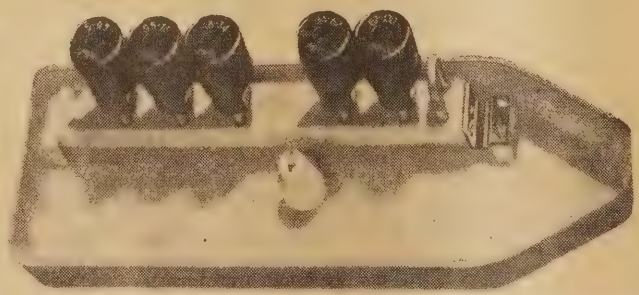

R. F. GENERATORS

Type GM 2893: 90 Kc/s—50 Mc/s

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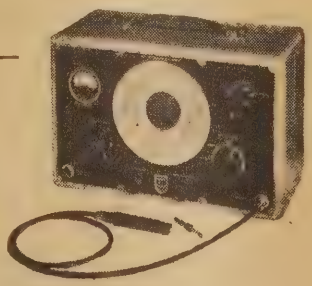
Type GM 2883: 90 Kc/s—30 Mc/s

Incorporating: Turret band changing metered output. 270°, illuminated scale expanded I.F. range 400 Kc/s-500 Kc/s.



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PS901-

be pre-assembled on an insulating strip and wired into the circuit with very short leads.

To illustrate the point we have shown a large underchassis photograph in which virtually every component is clearly visible, which is the best kind of wiring diagram.

This layout should be suitable for any similar amplifier, large or small, with suitable modifications to chassis size.

Connection to the control unit is made by means of an octal socket mounted on the front edge of the chassis. This is so orientated as to bring the grid connections as near as possible to the 6CG6 valve socket. One input lead has an earthed socket pin on each side, and on the far side of the second input pin is the highly filtered high tension lead for the control unit itself. Other socket pins carry the high tension for the tuner and the filament leads for the valves in control unit and tuner.

COAXIAL CABLE

Both signal input leads are made with low capacity co-ax or microphone cable. It is convenient to use a single socket for all these connections, and we have not found it necessary to separate out the signal input leads from the rest. Any channel leakage is so low it can be ignored.

At the plate connections to the first valve the channels divide into two completely symmetrical layouts which move towards the output transformers at the rear.

The cathode and grid resistors of the phase changers are mounted to a small tag strip near the front edge of the chassis, but the remaining components are mounted on the terminal strip which runs across the chassis between the phase changers and the output valves. The components have been so arranged that very short leads are needed to connect the valve sockets to the components.

Underneath the tag strip a wire connects the high tension ends of the appropriate resistors and another picks up the earthed ends. The high tension comes into the strip through the decoupling resistor — actually two .047 one-watt resistors in parallel.

A 24 mfd decoupling electrolytic bypasses the feed point.

The earthing lead is connected to the bolt which supports the strip in its centre and all earthing for the voltage amplifiers and phase changers, together with the input socket earthing, connects to the chassis at this point.

STRIP PRE-WIRED

All the components can be mounted and the various feed points connected up before the strip is bolted to the chassis. Ordinary one-eighth bolts are used to space the strip about 1½ inches clear of the chassis.

In the centre of the strip the 6CG6 cathode bias resistors and their bypasses are mounted so that convenient leads can be run to the voice coil windings of the transformers for feedback. The phase correction capacitors are connected directly across the 6,800 ohm feedback resistors.

The circuit shows individual cathode bias circuits for the output valves, and these are earthed to points at the rear of the chassis. It is not absolutely necessary to use separate circuits, but it is the preferred method of so doing, slightly increasing low frequency stability and compensating to some degree for small degrees of unbalance.

It is cheaper and quite permissable to use a single cathode bias resistor for each pair, of half the present value, and preferably bypassed in each case.

The power supply components are all mounted to one side of the chassis. By using dual electrolytics, the connecting lugs can be used to support the feed resistors for the control unit and the tuner.

The voltage control resistors in the rectifier plate leads are mounted on a small terminal board at the side of the chassis. They could be bridged across the unused pins of the rectifier socket, but this isn't quite as firm a mounting.

The frequency curves and oscillograph patterns give a good idea of the amplifier's performance, both channels being identical in this respect.

With the compensating circuits included, response is virtually flat from 20 cycles to 100 Kc., falling away fairly smoothly afterwards to minus 12 db at 500 Kc.

The square wave with these transformers is not completely free from ringing, which occurs at a high frequency probably coinciding with the bend in the response curve in the extreme top end. It is quite negligible as a factor in performance.

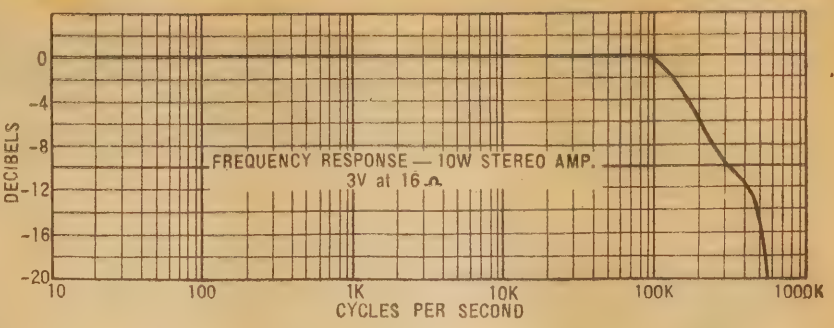
SQUARE WAVE OUTPUT

The square wave performance is virtually identical for resistive or speaker load, and on open circuit.

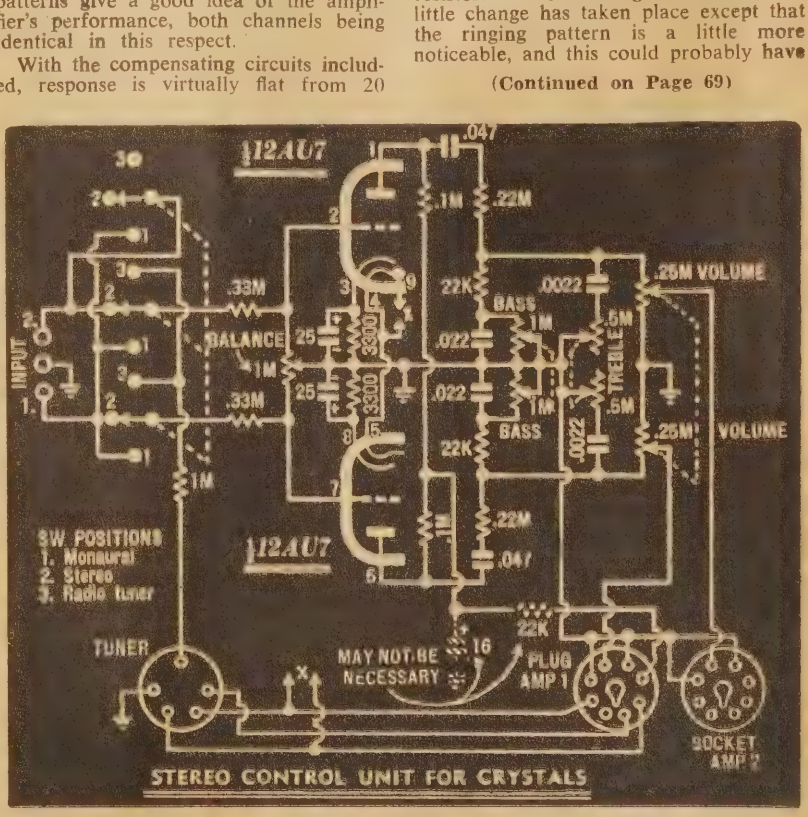
To illustrate the stability of the amplifier, feedback was increased to 32 db by reducing the value of the feedback resistor. The oscillograms show that little change has taken place except that the ringing pattern is a little more noticeable, and this could probably have

(Continued on Page 69)

CURVE OF FREQUENCY RESPONSE



The overall response curve is flat to 100Kc, tapering thereafter as shown. While well beyond the audible range, the behaviour of the amplifier in this region is indicative of its stability with transient input.



Reprinted from the October 1958 issue, this stereo control unit for crystal pickups is well suited for use with the new amplifier

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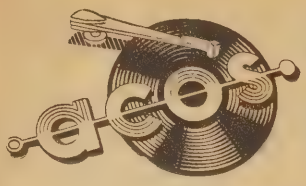

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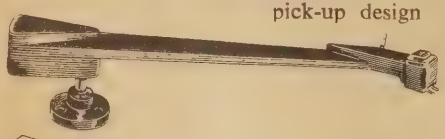

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GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through low-gain amplifiers as used in small record players (GP59-3 cartridge) **PRICE £4/19/6**

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GP10: Is a crystal pick-up utilising the GP9 cartridge. combining purity of reproduction with extreme reliability, resonance-free response from 50/8,000 c.p.s. Output. 1.5v at 1,000 c.p.s. (GP9 cartridge).
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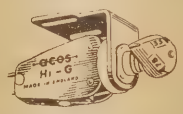

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TRANSISTOR TEMPERATURE "OVEN"

Transistor parameters are critically dependant on temperature. Calculation of operating conditions and stabilising circuits from manufacturers' data is necessary but requires confirmation with a range of transistor samples of the particular type. A quick and inexpensive method of checking transistor circuits over a wide temperature range is described.

TO normal design problems, that of maintaining stable operation over a range of temperatures is added in the case of transistor amplifier circuits.

Circuit stability is obtained by the addition of components which complicate the equipment and consume power. A good design, therefore, is one which uses the minimum number of components and consumes the minimum amount of power, at the same time giving the required performance over the required temperature range.

In practice, the best design is usually a compromise.

In order to confirm that the compromise is workable in practice, it is desirable to test the circuit over the temperature range required, and with a number of transistors having characteristics on both sides of the "bogy" or published figure.

TEMPERATURE RANGE

Designers will be concerned mainly with germanium transistors at the present time and operating over a temperature range from 0 degrees C to 50 degrees C (32 degrees F. to 122 degrees F.). Ideally a means should be available whereby the temperature of the test transistors can be maintained at any point within the range and quickly varied to any other temperature.

A method frequently used in the past for testing radio equipment is to place it in a thermally insulated oven with a heating element, thermometer, and with a fan to circulate air and maintain an even temperature throughout. The entire equipment is often placed inside the oven with leads connecting via insulated leads in a wall or the door of the oven.

Ordinarily this type of oven is suitable only for tests above ambient temperature, since a source of cool air is not available. It has the disadvantage, in practice, that the thermal capacity of the inside of the oven, plus the equipment, plus the air, is high. Also the thermal resistance between the heating element and the components under test is high. The practical result of this is that the system takes a long time to stabilise at the required temperature.

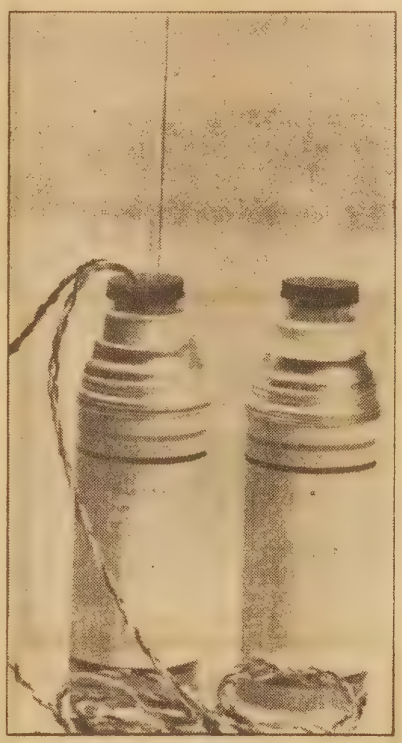
ELECTRICAL ANALOGY

The thermal circuit is analogous with a series electrical circuit containing a battery, a resistor and a capacitor, where the battery is the equivalent of the heating element, the resistor the thermal resistance and the capacitor is the equivalent of the apparatus under test.

In the electrical circuit, if both the resistance and capacitance are high, the time taken for the capacitor voltage to follow a change in the battery voltage is long.

It is an obvious advantage if the mass or quantity of equipment, requiring to be investigated in regard to temperature sensitivity, can be minimised.

Modern resistors and capacitors are stable components compared with transistors over the temperature range mentioned and for many purposes it can be assumed, with negligible error, that none of their characteristics change. This being the case, the temperature of the transistors only need be varied, with the possibility of simplifying the equipment by so doing.



Two domestic vacuum flasks, plus a thermometer and a few miniature sockets permit checks of transistor characteristics over full temperature range.

The thermometer and two transistors installed in the cork stopper.

We have found a method, which involves the use of one or more vacuum flasks containing water at the required temperature, very satisfactory. The transistors plus a monitoring thermometer, are placed in water in the flask and leads brought out to the external circuit.

Since the thermal capacity of two or three small transistors plus the thermometer is normally small compared with the thermal capacity of the water, the temperature of the latter will remain relatively constant over a long period and allow repeated tests at high and at low temperatures if required.

Heat loss from modern vacuum flasks is very small. Experiments can be extended over several hours with little change in temperature, especially if care is taken to replace the cork stopper when the flask is not actually in use.

A convenient standard of lower temperature is that of melting ice at 0 degrees C or 32 degrees F. Since the latent heat of fusion of ice is 80 calories per gram, the 0 degrees C can be maintained for a much longer period than the higher temperatures without changing the contents of the flask, if it is originally filled with crushed ice and water. A domestic refrigerator is a convenient source of supply.

The thermal resistance between the transistor collector and the heat sink will be less when the transistors are immersed in water than when they are normally installed with air as the cooling fluid. Therefore some allowance for the difference would have to be made when a transistor is operating at high collector dissipation and good accuracy is required. The temperature of the water inside the vacuum flask would, in fact, have to be higher to simulate a given air temperature.

PROBABLE ERROR

If precise measurements are required, a given transistor could be operated at a set dissipation in air at atmospheric temperature and then transferred to water at the same temperature and the difference in Ico used to provide an indication of the difference in collector temperature and hence thermal resistance. Such measures may not always be justified.

For our purposes a pair of 8oz capacity domestic vacuum flasks were found to be satisfactory. The cork stopper was bored to take a thermometer with the aid of a cork borer. Holes were also made for the miniature three contact sockets.

Leads, suitably colour coded, were soldered to the transistor sockets and pressed into place. The thermometer was placed in a position such that the bulb was at the same height at the transistors with full-lead length. The object was to prevent errors in the event of there being temperature layers in the water.

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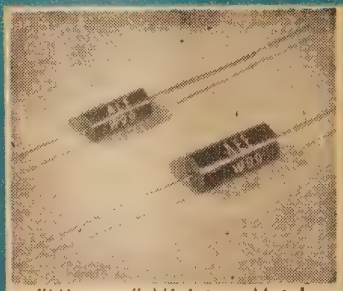

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An immersion type thermometer with an elevated position for 32 degrees F is desirable. The difference in level between the transistor body and the top of the stopper may be 4in or more and it is highly desirable that the entire scale be visible.

A socket or a pair of miniature terminals to allow a thermistor to be placed in the vacuum flask with the transistors when compensating circuits are being tested may be a desirable addition.

Some means must be found to electrically insulate the transistor leads since it is not practical to adjust the water level to cover the transistor body only and in any case condensation is a problem.

LACQUER COATING

We found it satisfactory to give each transistor several coats of clear lacquer by dipping. If interchangeability of transistors in the test device is required it is not satisfactory to cover the ends of the leads and the sockets with lacquer. A possibility is to apply a coating of high-melting-point grease around the socket and unlacquered ends of the leads.

For small transistors, the collector is usually insulated electrically from the case and therefore there is no need to insulate the body of the transistor from the water. Depending on the thermal contact required, you can please yourself on this point.

Needless to say, only the DC and low audio frequency operating conditions of the transistors can be investigated satisfactorily due to the need for long connecting leads. However, once the DC operating conditions are established, the HF behaviour of the circuit may be studied with the transistor wired directly in place.

For the purposes of checking calculated designs at "Radio, Television and Hobbies," we have found that two vacuum flasks are sufficient, one containing water at, say, 130 degrees F and the other ice water. Conditions at room temperature can be checked without a flask or to save time a glass of water from the cold tap may be used.

Transition between the upper and lower temperature is very rapid and for most measurements one minute is sufficient to allow conditions to stabilise before taking readings.

We have had no difficulty with the seals of any transistors tested when subjected to sudden changes from one to the other of the extremes mentioned and do not anticipate that it will be a problem. The system has proved very satisfactory in our own case and could well be of interest to small laboratories and individual experimenters who cannot invest in the traditional and more elaborate equipment.

When working with high voltage equipment keep your full attention on what you are doing. A moment's inattention can cause a nasty shock or perhaps worse where a few hundred volts or more are involved.

Capacitors need particular care because they are able to hold a charge after the apparatus has been switched off. Ordinary electrolytic and paper capacitors only hold a charge for a relatively short time but the larger paper capacitors have been known to hold a lethal charge for days. If in any doubt, short the capacitor terminals with a screwdriver with an insulated handle.

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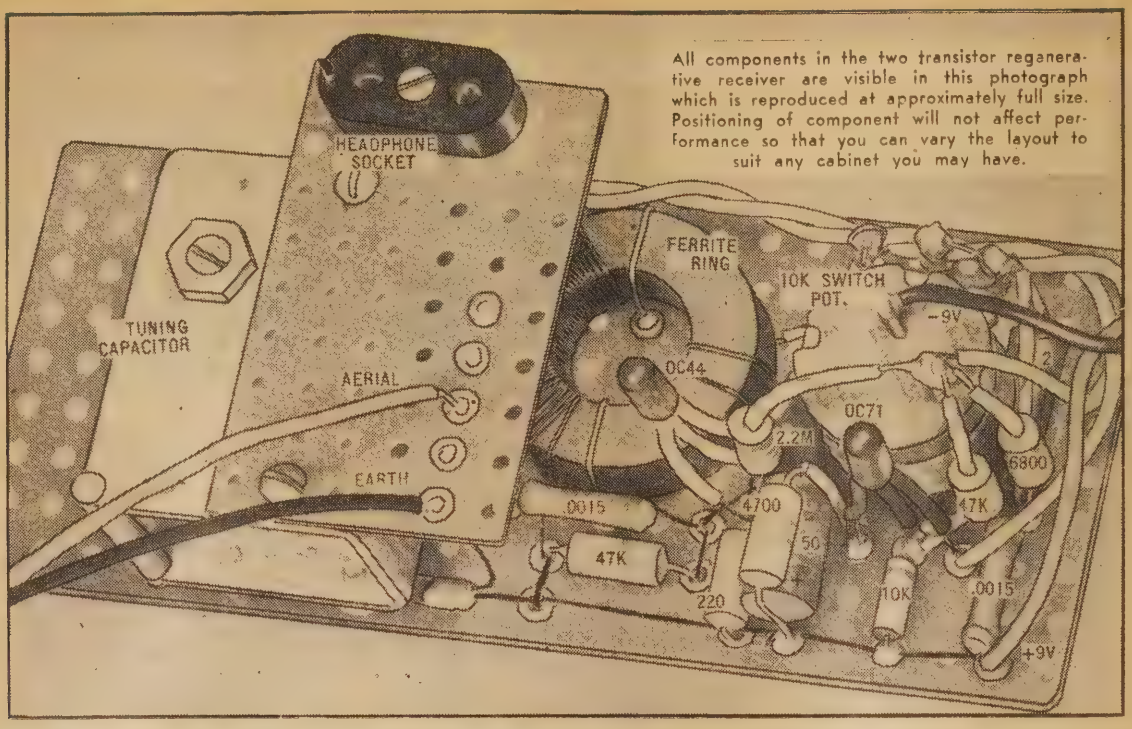


All components in the two transistor reganerative receiver are visible in this photograph which is reproduced at approximately full size. Positioning of component will not affect performance so that you can vary the layout to suit any cabinet you may have.

Adding Audio Stage To Transistor Set

An extra transistor plus a few small components added to our transistor receiver of last month give even better volume at low cost. The additions can be made with little change in the layout originally suggested.

ALTHOUGH we originally planned last month's receiver as a single stage job and with no thought for future additions, it turned out to be so easy to put an additional amplifier stage on the board that we decided readers may like to try it for themselves.

For the benefit of readers who may not have seen the article before reading this, we described a single transistor regenerative receiver using a modern RF type transistor. A large measure of the credit for the efficiency of the set goes to the tuning coil which was wound in the form of a toroid on a ferrite ring.

Despite the fact that the completed coil is less than 1½in diam. and ½in thick its efficiency is even better than the 4in diam. by 4in long coils which were used in the early days of radio in order to improve simple receivers. The coil is efficient because of the shape in which it is wound but mainly due to the quality of the ferrite material.

An efficient coil means that little energy has to be fed back in order to make the set oscillate. This in turn means smooth regeneration and high effective selectivity.

Excellent headphone reception of local stations is possible even with a modest aerial and, with careful adjustment of the regeneration, you will be able to hear quite a few interstate stations.

For a simple regenerative receiver with the aerial directly coupled to the tuned circuit, the best adjustment is a compromise between good volume on the one hand and good selectivity on the other.

If you couple the aerial tightly to the coil by connecting it to a tap towards the "top" you will tend to get better volume at the expense of selectivity. When you wish to select a weak station near in frequency to a strong local, good selectivity is needed. The aerial must be connected to a tap near the earthy end of the coil and hence the best volume you can obtain is limited

The addition of an audio amplifier stage may mean that sufficient volume can be obtained with the aerial connected towards the earthy end of the coil most of the time.

Therefore, the addition of an audio amplifier stage results in effective improvements in both volume and selectivity.

There is very little to the job of adding the extra stage—most readers will have the set operating within minutes of heating the soldering iron.

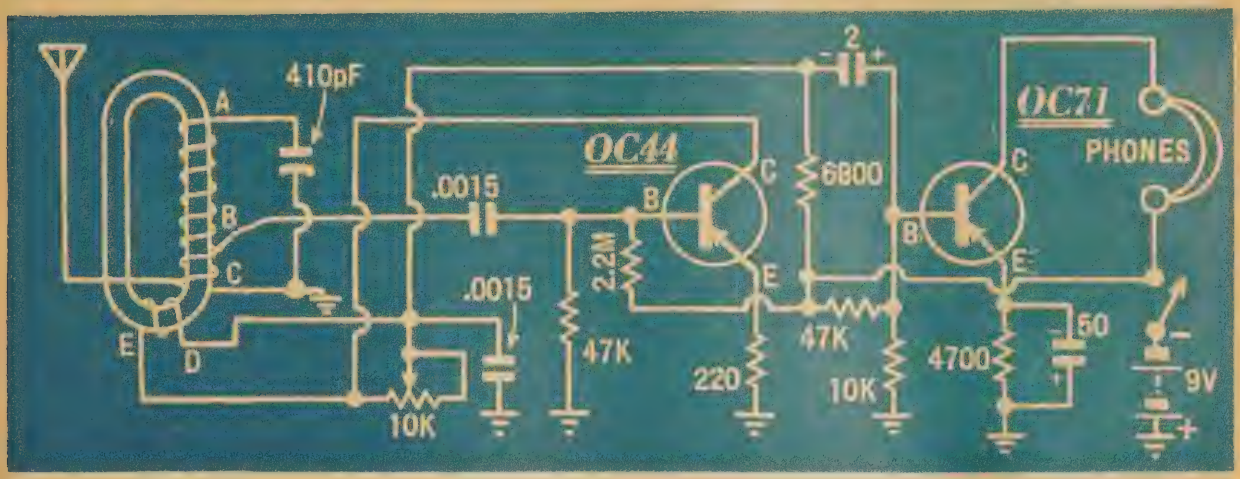
We have suggested two circuits and the one you use will depend on the type of headphones.

Normal "high impedance" phones sold throughout the regular supply channels have a DC resistance of the order of 4,000 ohms and an AC impedance of about 20,000 ohms. This type is best suited to small sets where the overall amplification is limited and, in most cases, will give the greatest volume with both the present set and the one described last month.

On the other hand, "low impedance"

by Maurice Findlay

CIRCUIT SHOWS ADDITIONS OF THE AUDIO STAGE



Except for the addition of an extra audio stage, the circuit is the same as that described last month. There are a large number of transistors suitable for the audio amplifier and all will give generally similar performance. This circuit is best suited for high resistance headphones.

phones having a DC resistance of the order of 100 ohms and an AC impedance of around 1,000 ohms are frequently available from disposals dealers at small cost. Although the gain will not be as great on weak stations the maximum power output from strong stations will be greater.

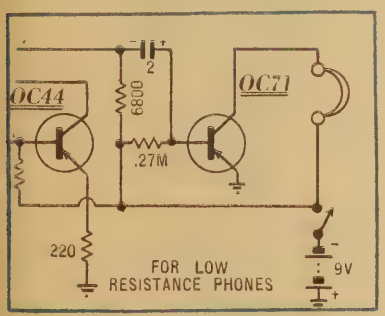
Perhaps these two statements sound paradoxical but you will appreciate their significance if you understand the difference between gain and maximum volume.

STABILISING CIRCUIT

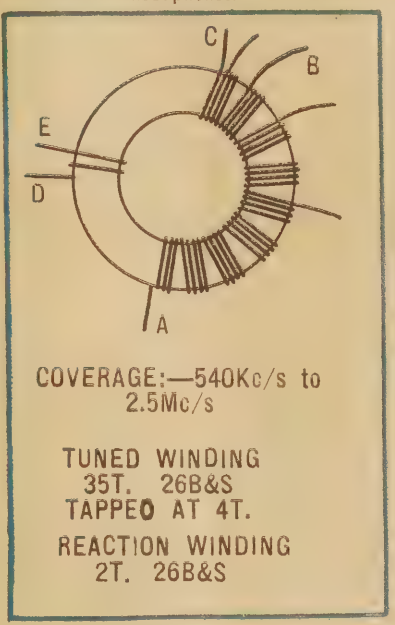
We won't labour the point just now because the maximum power output of the set feeding into either pair of phones is more than sufficient.

For the high-resistance phones it is necessary to include a stabilising circuit so that the operating point of the amplifier transistor does not change with temperature. We have worked out the best conditions for a 9-volt battery and a pair of high-impedance phones and included all the information in the main circuit.

It is not necessary to control the operating point of the transistor so closely when using the low-resistance phones and a much simpler arrangement is possible. All details are given in the small circuit.



If you wish to use a pair of low resistance phones, the above circuit will permit greater power output. It will not operate properly with high resistance headphones.



Details of the tuning inductor wound on the ferrite ring. The tap at "B" is for the base circuit of the transistor but we suggest that you add taps at 1T, 8T and 16T to permit optimum results with aerials of different lengths.

Crystal headphones are not often to be found in experimenters' parts boxes but it is worth noting that they are not suitable for either circuit as published. If you happen to have a pair in good condition, we suggest that you use the basic circuit for the high-impedance phones but substitute an audio choke for the phones as shown on the diagram. One terminal of the crystal phones should then be connected to earth and the other to the collector terminal of the output transistor, via a 0.1 uF capacitor.

Although perhaps not as reliable as magnetic phones under conditions of high temperature and high humidity, crystal types in good condition are usually very sensitive and capable of producing audio with excellent quality.

MINIATURE JACKS

By the way, during the month we have seen some excellent miniature phone jacks and matching plugs around the radio stores. Of Japanese origin, the two together are only 1 inch long. The diameter of plug is about 1/8th inch. Cost is only a few shillings.

Current drain of the complete receiver wired to either circuit is very small. Wired for high-impedance phones,

(Continued on Page 104)

PARTS LIST

(For high resistance headphones)

- 1 piece of bakelite 5½in by 2 3/8in.
- 1 piece of bakelite 2 3/8in by 1½in.
- 1 detector transistor: OC44, 2N252, OC45, 2N308 or 2N309
- 1 audio transistor: OC71, OC66, TS2, TS3, OC70, OC65 or TS1.
- 1 single section tuning capacitor (10 to 400 pF approx.).
- 1 50 uF 12VW capacitor.
- 1 2 uF 12VW capacitor.
- 2 .0015 mica or ceramic capacitors.
- 1 10,000 ohm carbon potentiometer with switch.
- 1 2.2 meg. resistor.
- 2 .047 meg. resistors.
- 1 10,000 ohm resistor.
- 1 6,800 ohm resistor.
- 1 4,700 ohm resistor
- 1 220 ohm resistor.
- 1 pair of high resistance headphones.
- 1 miniature crystal socket.
- 1 battery (4.5 volt to 9 volt).
- 1 ferrite ring, type F4021.

Hook-up wire, tinned copper wire, 26 B. and S. enam. wire, nuts and bolts, eyelets, 2 knobs, wooden or bakelite cabinet if required.

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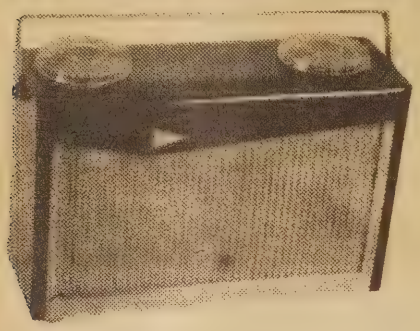

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103	Second video 6BX6	14
104	Third video 6BX6	14
105	Fourth video 6BX6	14/
106	Fifth video 6BX6	14
110	First C.T. Sound	11/6
107	First Sound ifitar	11/6
108	Second Sound bifilar	11/6
109	Third Sound ratio detector	18/

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56	Power transformers 12v 1.5 amp.	24/5
60	Filter choke 100mA 30h	15/4
66	Filter choke 14h 60mA	10/8
80	2.5v 1.75 amp. 5 kv ins	26/8
61	4v 1 amp. 5kv ins	26/8
62	6.3v .6 amp. 5 kv ins.	26/8
63	Frame output trans. 6BM8	33/4
220	EHT supply 3000v Osc. coil	26/8
77	3h. 300mA	20
78	1h. 300mA	20/
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FROM THE SERVICEMAN WHO TELLS

In spite of advances in the electronic art, the making of completely foolproof equipment for use by the general public still calls for a lot of thought. Two jobs I handled recently emphasise this. Both were portable amplifiers, both were used by non-technical types, and both suffered as a result of mis-handling.

THE first was a guitar amplifier. It appeared to be a small-scale manufacturer's job, though very well made, and I suspect that it was at least based on a circuit published in "Radio and Hobbies" about four years ago. It used a pair of 6BW6's in the output stage, a 12AX7 as an amplifier and phase changer, and an EF86 as a pre-amplifier.

The owner had several complaints. There was an objectionable crackling-cum-hissing noise which worried him a great deal, and this seemed to be tied in with the movement of the cord from the guitar to some extent. There was also a noticeable hum level which he felt sure had not been there when the unit was new.

A less specific fault, but the one which worried him most, was a falling off in performance generally. He found it difficult to explain this accurately, although the gist of it seemed to be lack of adequate volume. What seemed to confuse him in this regard was the fact that there was still plenty of movement left in the volume control.

Although it seemed to be a fairly obvious case of lost power output, rather than lost sensitivity, I refrained from trying to explain this subtle difference. Experience has taught me that it is often hard enough to explain the distinction to those who should know already, and virtually impossible to get across to the non-technical mind.

CONFIRMATION

A test on the bench confirmed most of these faults, at least in a general way. There was no doubt about the noise, and this did seem to be aggravated by moving the input plug, but I was not convinced that all the noise was coming from this source.

I could also detect some hum, but it was not immediately clear how much of this was coming from the amplifier proper, and how much might be due to magnetic coupling between the power transformer and the pickup unit on the guitar, the latter being a magnetic type used in conjunction with steel strings.

The lack of power output was not quite so obvious, mainly because even a couple of watts still makes a lot of noise in a relatively small workshop. I anticipated that I might have to measure this to be perfectly sure unless some very obvious defect was discovered.

As it happened, just such a defect presented itself almost immediately. Opening the back of the case revealed one of the 6BW6's leaning over at a drunken angle which must have been placing a severe strain on both pins and socket. The heater was still alight, but I had my doubts about the other vital connections.

Even more interesting was what appeared to be the cause of this condition. The back of the cabinet was made in two parts; a small permanent lower section slightly higher than the chassis, and a larger section, held by pins and patent fastenings so that it could be quickly removed and replaced.

I remembered how, when the customer had delivered the unit to the shop, he had opened this portion, fished out a handful of power cord, and replaced the panel without even bothering to look inside. A small cut-out in the bottom of the loose panel provided an entry point for the cord when the unit was in use.

I now realise that he made a habit of storing the power cord — and there were several yards of it — in the space immediately above the valves. It was not hard to imagine the effect when a bundle of cord was pushed hurriedly into this space and the back closed on it. Unless circumstances were very fortunate it was almost inevitable that too much cable would become jammed between the back and one of the valves.

Before disturbing anything, I fed some signal into the front end of the amplifier to serve as some kind of reference, then wiggled the drunken valve gently in its socket. The result was a series of crackles and a brief but noticeable improvement in performance, though the latter effect was only obtainable in one very critical position.

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—TV Times

To put the matter beyond doubt, I briefly removed the opposite 6BW6 from its socket. The result was complete silence; conclusive proof that the amplifier had been limping along on one output valve. The loss of this valve, along with the fact that the remaining valve would be working into only one-quarter of the original load, would mean a very serious loss of power output.

Since I gather that amplifiers of this kind have to handle a fairly wide dynamic range and are often driven right to the limit of their available power, it is not surprising that the user was conscious of the unit's deficiency.

Removing the valve from its socket I carefully straightened the pins, and checked to make sure that neither this operation or the previous abuse had fractured the glass. Then I tackled the socket. The contacts had obviously been forced open by the strain and there was a possibility that the socket would have to be changed. First, however, I decided to try a little "doctoring."

SOCKET REPAIR

It was a moulded type socket and I managed to insert the point of a thin sharp scriber between the contact and the wall of the pocket in which it rested. By exerting gentle pressure this half of the contact was forced back toward its neighbour and its original position. Repeating the procedure on the other side of the pocket completed that particular contact.

It took only a few minutes to go right around the socket in this manner, and all the contacts appeared to respond quite readily. When I replaced the valve the firm grip of the socket was very reassuring.

Although this was the most obvious cause of lost power, it was not the only possibility. Either or both valves could be sick, or faulty power supply components could cause loss of HT voltage. And it doesn't need much drop in voltage to seriously affect power output.

Both valves checked OK, and I followed this with a complete voltage check. Most of the voltages, including the main HT voltage, appeared normal, the only suspect being the bias voltage across the output stage cathode resistor.

This appeared to be a trifle on the high side, and I moved the prod to the grid of one of the 6BW6s. Sure enough, there was a perceptible forward movement; a sure indication of positive voltage reaching the grid from some source.

COUPLING CAPACITOR

The coupling capacitor is the usual suspect in these cases and I was even more suspicious when I checked the brand. It was an imported unit, and one which previous experience had shown to be decidedly unreliable — at least in this application. Lifting one end of it removed the positive bias and put the matter beyond doubt.

There were four coupling capacitors

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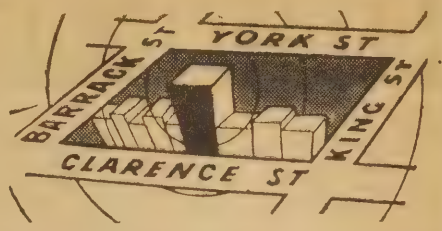

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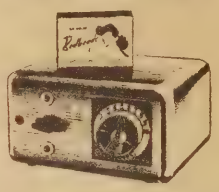

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altogether, and all of the same brand. I had no hesitation in scrapping them all, without bothering to test them. From what I knew of them it would be only a matter of time before they gave trouble, even if they tested OK now. In their place I fitted some locally made high temperature types which experience has shown to be very reliable.

I had also hoped that this might clear up some of the crackling noise which had persisted thus far. Unfortunately it didn't, so that became next on the list.

Although some of the noise had appeared to come from the input plug, most of it was still evident when the volume control was turned off, meaning that it was originating within the amplifier. However, since the volume control was in the first grid circuit, it was not much help in locating the actual stage involved.

The trouble sounded like a noisy resistor, and I reasoned that such a fault would have to be somewhere near the front end of the system to make as much noise as it was. The grid resistor for the first half of the 12AX7, or the plate resistor for the EF86 seemed the most logical possibilities.

FINDING THE STAGE

Lifting the coupling capacitor between these two resistors stopped the trouble, eliminating the 12AX7 grid resistor or components beyond that point.

(I was still only assuming that the trouble was a resistor; it could also hav. been a valve, but I had at least determined the stage involved.)

Still convinced that it "sounded" like a resistor, I lifted one end of the plate load and strung a new resistor temporarily into place. When this completely eliminated the trouble I considered my point proved.

Next I advanced the volume control and tried moving the guitar plug in the input socket. This also brought forth some crackles, showing that it had certainly been a contributory cause.

The plug and socket were of the P.M.G. type, more usually known as a plug and jack combination, which appears to have been adopted almost universally by the guitar manufacturers. The wisdom of this choice is open to debate, but, being stuck with it, I had to do the best I could.

CLEAN-UP

I could find nothing drastically wrong, but spent some time cleaning the tip and sleeve of the plug with fine emery cloth, and cleaning and adjusting the spring contacts in the jack. This seemed to remove the last trace of noise, but I cannot say how it will stand up to the manhandling such devices usually experi nce in this class of service.

As I said earlier, the wisdom of choosing these units is open to debate. They were never intended for low level high imp dance circuits, and are almost incapable of being completely shielded, as well as having mechanical disadvantages.

Proper microphone connections would appear to be a very much better choice, having much more suitable electrical and mechanical characteristics for this application. Unfortunately, once a "standard" has been adopted, it becomes very hard to break it, no matter how undesirable it might be.

This was a typical example. I would have liked to scrap these fittings and substitute microphone connectors, but such a change would immediately render the amplifier unsuitable for use with other guitars; something which I knew the owner would consider undesirable So the original fittings had to stay.

The final problem was the hum. Carefully placing the guitar well away from any possible source of magnetic fields (not such an easy task in a serviceman's workshop), I checked the level again It seemed higher than it should be, as well as being predominently 100 cycle, so I turned my attention to the electrolytics.

A few minutes spent bridging these with a new one revealed the "1st" as the culprit, the objectionable ripple vanishing as soon as it was bridged. To be truthful, it is doubtful whether anyone other than the user and myself had ever been conscious of the hum, but there was no doubt that it would become progressively worse if the capacitor was not replaced.

As a final test, I picked up the steel and plectrum and strummed a group of chords which sounded very impressive—even if they did not have any particular musical significance. Then (having found the right string) I picked out my own version of "The Maori's Farewell," a version which I admit made the instrument sound more likt a one-string fiddle than a guitar.

Still, I reckoned that was fair enough for a serviceman.

When the owner came to collect the unit, I explained how the power cord had caused so much bother. After studying the inside of the case we decided that it might be possible to fit a small partition near the top of the case to form a receptacle for the cord. In the meantime, it would be necessary to exercise rather more care in stowing the cord in its old position.

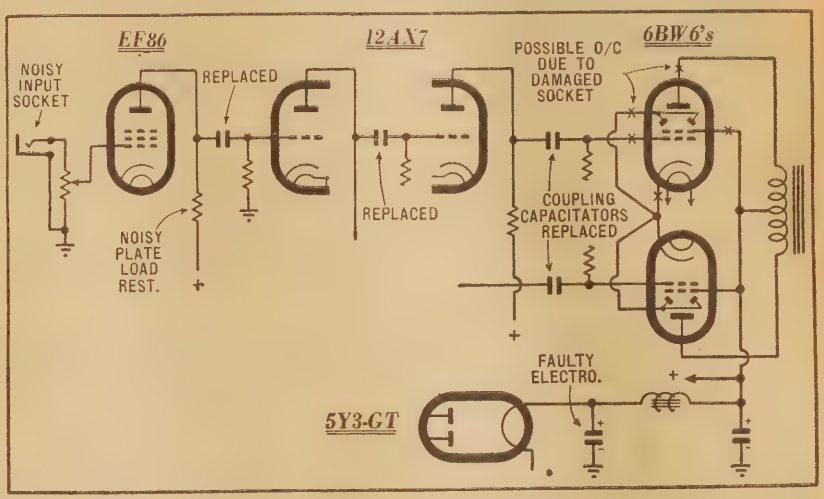
P.A. SYSTEM

Case number two concerns a vibrator/AC operated P.A. system used by a local charity for their various social and fund-raising activities. Stories concerning it have appeared in these columns on a number of previous occasions.

As is usual with these devices, it takes a pretty solid bashing one way and another. Man-handled from place to place, tossed in and out of trucks and cars, used by unskilled persons, and out in all weathers, it is not surprising that it needs fairly frequent servicing.

When it turned up this time the general nature of the fault was immediately obvious. The battery cable was a discoloured gooey mess of fried rubber, with short lengths of bare wire showing through at odd intervals. It didn't take a genius to see that it had suffered a pretty serious short of some kind.

The story accompanying it was to the effect that it had been set up for a particular gathering, but had never functioned beyond the testing stage. When first switched on, it appeared to warm up in the normal manner, made a few spluttering sounds, then gave forth copious clouds of acrid smoke from the battery cable. It had been rapidly disconnected and the meeting was forced to proceed without it.



Failure of one half of the output stage—due to careless stowing of the power cord—was the major fault with this guitar amplifer, but a number of minor faults also were found and corrected. All available power output is required with such amplifiers.

THE VIBRATOR?

My first reaction was to assume that the vibrator had developed a set of sticky primary contacts or some other form of short. However, a preliminary check across the battery clips with the ohm meter showed no signs of a short—in spite of the damaged cable.

Thus encouraged, I took the risk of touching the clips across the bench battery. When there was no sign of distress I connected them more permanently, though still on the alert to whip one off at the first sign of trouble.

Strangely enough, nothing unusual occurred. What is more, the vibrator was purring away merrily, there were signs of life in the speaker, and everything appeared to be functioning normally. Final confirmation was provided when I connected the microphone and checked the complete system. Everything did, in fact, appear to be in order.

So what had happened? Either the effect was intermittent (perish the thought) or it was a result of incorrect setting up on somebody's part. I was more inclined to suspect the latter, particularly when further examination revealed two interesting points.

One was the fact that only one of the two battery leads, the "earthy" one, ap-

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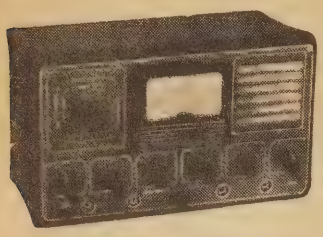

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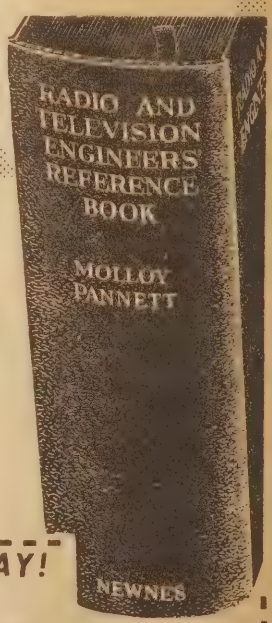

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peared to have been directly damaged. Admittedly this was hard to detect where both leads were housed in a common covering, but was plainly evident where they separated near the battery end of the cable.

The other was the fact that there was a fuse in the active lead and which should have blown in any circumstances likely to cause such obvious damage. I double checked to make sure that it was, in fact, a fuse and not a piece of fencing wire or similar improvisation.

Putting speculation aside for the time being I concentrated on replacing the damaged battery lead, giving the entire amplifier a fairly thorough overhaul, and cleaning up a few minor troubles, mainly mechanical, likely to give more trouble in the future.

A LITTLE HISTORY

When the organisation's secretary called in to pick up the unit I put a few questions to him concerning the manner in which the unit had been used on the fateful occasion. In particular I wanted to know the make of vehicle used to supply the battery power, and whether the amplifier had been in contact with any part of the vehicle while in operation.

His answer provided final confirmation of my theory. The vehicle was of a make I knew to have a positive earth system and, yes, the secretary remembered that the amplifier had been resting on a convenient flat mudguard of the truck concerned.

The picture was now fairly clear. The amplifier employs a non-synchronous vibrator and valve rectifier, meaning that it may be connected to a battery either way round and still function. However, because it is also designed for AC operation, one side of the heater system has to be earthed.

This means, in turn, that one of the battery leads must be earthy. This is of no consequence provided that this earth lead is always connected to the earthy side of the car electrical system, regardless of the polarity of the latter.

Even if this precaution is disregarded it would not matter particularly provided the amplifier frame was not brought in contact with the vehicle frame. However, when this did occur, things began to happen in a hurry.

DEAD SHORT

With the earthy lead of the amplifier connected to the active side of the electrical system, and the metal case of the amplifier resting on the frame of the truck, there was a direct short through the earthy lead; and without the benefit of a fuse or anything else to protect it. Not much wonder the lead became hot and bothered.

I rather gathered that effective contact between the amplifier and truck frames did not occur immediately. Apparently the duco provided a satisfactory insulation at first, and this should have been supplemented by a set of rubber feet on the underside of the amplifier. Unfortunately, these latter were pretty well worn, allowing the heads of the mounting bolts to protrude slightly.

One of these either scratched its way through the duco or happened to find itself over a spot already devoid of paint. I rather suspect the latter, since I understand that the truck had quite an array of battle scars. Presumably the initial response of the amplifier occurred before this break-through, and which was probably aggravated by someone moving the case slightly.

The ironic part of the story is that, had someone known sufficient about what was going on to lift the amplifier clear of the truck, or even insulate it with a newspaper or floor mat, the amplifier would most probably have seen the job through.

I explained all this as simply as possible to the secretary, and pointed out that the red and black markings on the battery clips were intended to indicate "active" and "earth" rather than "positive" and "negative" in the literal sense.

I only hope that he, and his off-siders, can appreciate and remember the difference. If they don't it's only a matter of time before they have another display of fireworks.

And, to round things off, here is a story in somewhat lighter vein; even though I'm sure it contains a moral somewhere.

There is probably nothing more likely to deflate the ego than the outspoken—but usually unconscious—philosophy of the very young. A typical—and rather amusing—example of this was related to me recently by a colleague.

The story hinges on the fact this chap had built his own TV receiver. Being fairly experienced in the radio game, he has not encountered any serious difficulties, and the set had delivered good quality pictures almost from the moment of switching on.

JUSTIFIABLE PRIDE

I imagine he had felt the same thrill of pride that most of us experience when we carry some new project through to a successful conclusion; particularly something as new as a TV set. At the same time, he was inclined to be somewhat reticent about it when questioned by friends and neighbours, not wanting to be thought boastful on the subject.

His wife, however, had no such inhibitions. As far as she was concerned, her husband was Marconi, Edison, and Baird all rolled into one, and she didn't care who knew it. Nothing delighted her more than to be asked what kind of TV set she had, so that she could reply, with an air of studied casualness, "Oh, my husband built ours."

From then on, she simply basked in reflected glory, while other wives made envious comments and recited their own husbands' short-comings. ("George is quite useless at anything like that, my dear. I have to call a plumber just to put a washer on the tap," etc.). Thus it was that my friend's fame spread up and down the street, and, he suspects, a good deal further.

It was against this background that the final ego-deflating scene was enacted. His wife — whom we shall call Mrs Smith — answered a knock on her front door to find two schoolboys on the doorstep. She recognised them as brothers, aged about nine and eleven respectively, belonging to a distant neighbour in the same street, and it transpired that they had been sent on a minor errand of some kind.

DID HE OR DIDN'T HE?

She left them at the front door for a couple of minutes while attending to the message they had brought, and returned to find them engaged in a somewhat heated argument. However, apart from the fact that it was along the lines of "He did," "I betcha he didn't," "I tell ya he did," etc., she had no idea of what it was all about.

However, after the official business of the visit had been concluded, the youngsters seemed to hesitate. When the silence became intolerable the elder one suddenly blurtd out: "Mrs Smith, did Mr Smith really make your TV set?"

"Yes, he did," replied Mrs Smith, experiencing once again a thrill of pride. But the youngster still hesitated. It seemed he wasn't satisfied. "But," he persisted, "did he make it all himself?"

"Yes, he made it all himself."

At this stage the younger lad could contain himself no longer.

"But he had to buy the nuts and bolts, didn't he?"

"Oh yes, he had to buy the nuts and bolts, of course," replied Mrs Smith, somewhat taken aback at this line of questioning.

The younger lad turned on his elder brother. "There y'are!" he yelled triumphantly, "I told ya he didn't make it ALL himself"

EVEN LOWER

As my colleague put it when he laughingly related this story, one wonders how much lower he would have sunk in the youngster's estimation had the latter known that he had also had to buy the valves, the picture tube, the transformers, chokes, resistors, capacitors, and so on. That he had, in fact, not really made the set at all in the sense which the youngster would understand it. All he had done was to assemble some ready-made parts.

It is surely a commentary on the times in which we live, that we regard as "raw material" components which, in themselves, are highly complex devices, way beyond the manufacturing capabilities of any one person. And in addition, that the assembly of these complex devices into the finished product, and their adjustment for correct operation, is a sufficiently complex process to justify it being regarded as a constructional process in its own right.

As I said at the beginning, I'm sure there's a moral somewhere.

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Thus, higher front-to-back resistance ratios sometimes are obtainable with silicon than with germanium. In some small silicon junction diodes the front-to-back resistance ratio at 1 volt may reach 100 million to 1.

The high back resistance disappears beyond Point B. At higher voltages the reverse current increases sharply, as from B to C, for a small increase in reverse voltage. Thus, with a few tenths of a volt the back resistance may fall abruptly from several megohms to a few ohms. (The current increases from a fraction of a microampere to several milliamperes.)

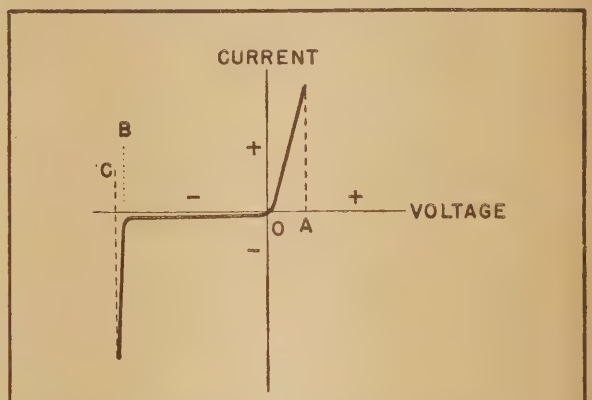
NOT BREAKDOWN

The extreme steepness of segment BC suggests breakdown of the diode, and is so termed, but this high-conduction interval is non-destructive, provided the maximum allowable power dissipation of the diode is not exceeded.

Point B is termed the zener voltage. Silicon junction diodes may be processed to place the zener point at a desired voltage level. Units so processed are called zener diodes. In such commercially available diodes the zener point (as specified for 25 degrees C operation) may be held as closely as plus or minus 1 per cent.

The important characteristic of the zener region (BC) is the high dI/dE, as well as the low E/I quotient. This characteristic gives the diode low DC resistance and low dynamic impedance and suits it to voltage regulation, peak compression, signal limiting, signal expansion, switching and similar applications. Zener diodes are available in both low and high power ratings, and with zener points between 2 and 300 volts.

The features which are of chief interest in the application of zener diodes are (1) the sharp "breakdown" characteristic, (2) the high ratio of resistance between B and C to that between O and B, and (3) the low-resistance and impedance of region BC. Hence, it is the reverse conduction of the zener diode which is most important in typical applications of this component. The forward characteristic (O to A in figure 1) seldom is of interest.



STATIC CONDUCTION CHARACTERISTIC OF ZENER DIODE

FIG. 1

In its operation and applications the zener diode is seen to be similar to the 2-element gas tube in the following respects: (1) both devices exhibit extremely high resistance until an applied voltage reaches a given breakdown potential, (2) the breakdown potential can be maintained closely by the manufacturer; (3) the breakdown is non-destructive; (4) beyond the breakdown point, current increases abruptly; (5) as the current is increased, the voltage drop across the diode remains substantially constant.

CONSTANT DROP

The constant voltage drop may be utilised in voltage regulators, compressors, limiters, clippers or slicers, voltage reference units and voltage standards. The sharp breakdown may be made the basis of wave-shapers, pulse formers, spike generators switches and discharge devices.

Gas diodes commonly are available for constant voltage drops from 75v (Type OA3, VR75) to 150v (Type OD3, VR150). These tubes may be series-connected for higher-voltage services. However, the lower limit remains 75 volts. Less precise operation at slightly lower voltages can be obtained with some neon lamps.

The zener diode, on the other hand, can be supplied for constant voltage drops as low as 2v and as high as 300 volts. Thus, this miniature component not only extends operation to lower levels than those afforded by the gas tube, but also permits high-voltage operation without having to series-connect several units in a regulator string. Still higher-voltage service is, of course, obtainable with the series connection.

The similarity between zener and gas-tube diodes ends with their comparable performance. The gas tube depends upon ionisation for its behaviour, while the semiconductor diode utilises field effects upon charge carriers within a semiconductor solid.

The zener diode finds many applications requiring the constant voltage drop abrupt breakdown which are characteristic of this component. In some applications, the miniature size and mechanical ruggedness of the zener diode give it preference over a gas tube having similar electrical characteristics.

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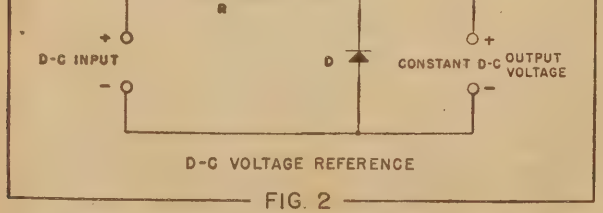
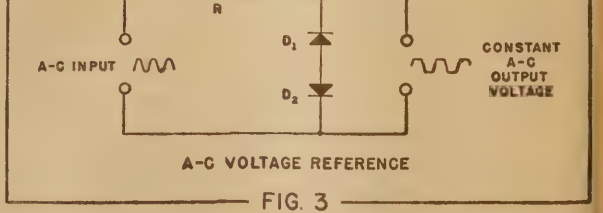


D-C VOLTAGE REFERENCE

FIG. 2



A-C VOLTAGE REFERENCE

FIG. 3

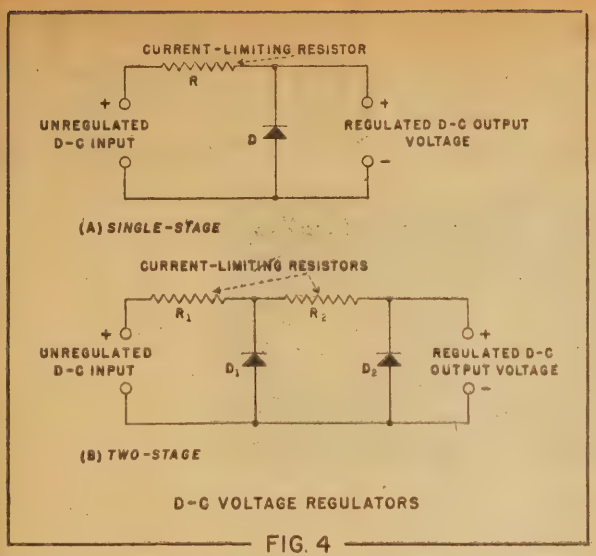


FIG. 4

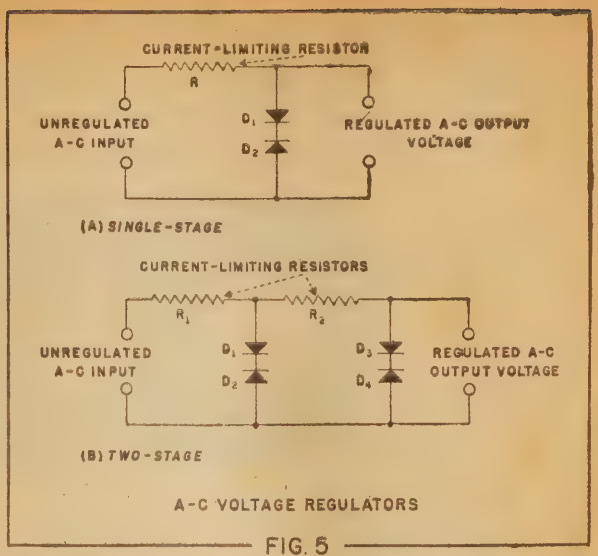


FIG. 5

Several typical applications are described in the following paragraphs. These examples will suggest further uses, and they do not exhaust possibilities by any means.

TYPICAL USES

Voltage References. The nearly constant voltage drop across a zener diode biased into its reverse high-conduction region can serve as a standard voltage for calibrating or referencing high-impedance circuits and instruments. The input voltage may be derived from an AC type power supply.

Figure 2 shows the circuit of a simple DC voltage reference. The input voltage must be at least four times the voltage desired across the zener diode, D. Theostat R is adjusted initially to set the diode current to the maximum value along the breakdown region (Point C in Figure 1) which may be maintained steadily without exceeding the rated power dissipation of the diode. In its state of high conduction, the diode acts as a low-resistance output element. This provides a fairly "stiff" voltage source. Diode manufacturers are able to supply zener diodes with voltages specified within 1 per cent.

Figure 3 shows a similar circuit for an AC standard voltage. Here, two zener diodes (D1 and D2) are connected back-to-back and act to limit both positive and negative output-voltage peaks to the standard amplitude. Except for the use of two diodes, the circuit is the same as the DC unit in Figure 2.

The output waveform, also shown in Figure 3, is that of a sharply clipped sine wave. In addition to other uses, this unit may be employed as a fixed-voltage calibrator for oscilloscopes.

VOLTAGE REGULATION

DC Voltage Regulators. The constant voltage drop across the zener diode operating in its breakdown region may be utilised as a source of regulated voltage. The output voltage is regulated against supply and load variations. The circuit resembles a gas-tube regulator circuit.

Figure 4 (A) shows a simple DC voltage regulator. In this circuit, the value of the current-limiting resistance, R, is chosen to set the the diode current to the maximum breakdown value (Point C in Figure 1) which may be maintained continuously without exceeding the rated power dissipation of the diode.

From the breakdown characteristic (Figure 1), it is seen that comparatively large input voltage swings, resulting in large current swings, will change the output voltage developed across diode D only slightly. Similarly, as the external load current increases, correspondingly less current flows through the diode. Good regulation is maintained as long as the diode current does not fall below that corresponding to Point B in Figure 1.

Additional regulation may be obtained by cascading two or more of as much as one order of magnitude higher than the desired output voltage, since voltage division is encountered in the successive regulator stages.

A particular advantage of the diode-type voltage regulator is its ability to function at low voltages. Previously, the simplicity of diode regulation has not been available below 75 volts, the lower limit of commercial gas-tube regulators.

At the same time, the zener diode regulator may be operated with a single diode, properly chosen regarding type, up to 300 volts—and higher with diodes connected in series.

A-C Voltage Regulators: Similar simple arrangements may be employed for AC voltage regulation.

Figure 5 (A) shows a single-stage regulator, and Figure 5 (B) a 2-stage cascaded regulator. Note that the only difference between these and the DC circuits are the double diodes in the AC units. Thus, in Figure 5 (A), diodes D1 and D2 are connected back-to-back to accommodate both AC half-cycles. In Figure 5 (B) each stage of the cascaded regulator contains such diode pairs (D1-D2 and D3-D4).

CLIPPED WAVEFORM

Either pairs of single diodes or double-anode diodes alone may be used. The output of the AC regulators is clipped as shown in Figure 3. The sine-wave shape may be restored to some extent through suitable filtering to remove the harmonics.

Zener Reference Diode in Transistorised Power Supplies: The simple DC voltage regulator circuits shown in Figure 4 are suitable only for light—and medium-duty applications, just as the gas-tube regulator is so limited. Furthermore, regulation closer than 5 to 10 per cent is not usual.

Heavy-duty, closely-regulated operation at low DC voltages is afforded by transistorised power supplies. In these units, zener diodes are employed as voltage reference units. Typical transistorised regulator circuits are shown in Figure 6.

Figure 6 (A) is a simple circuit em-

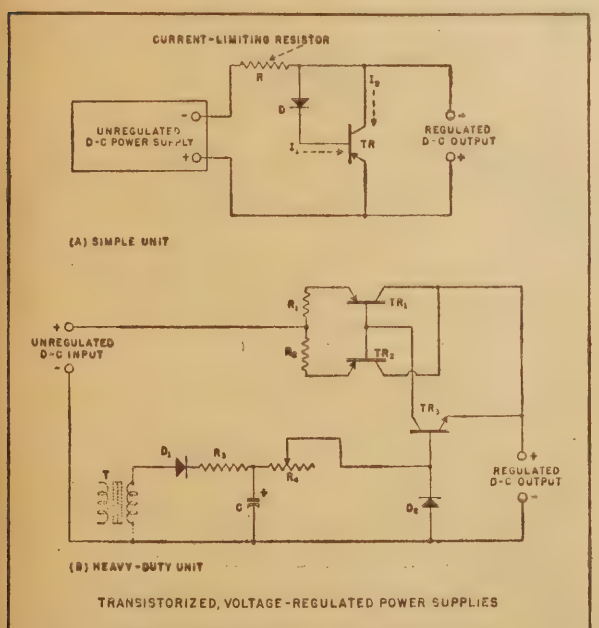
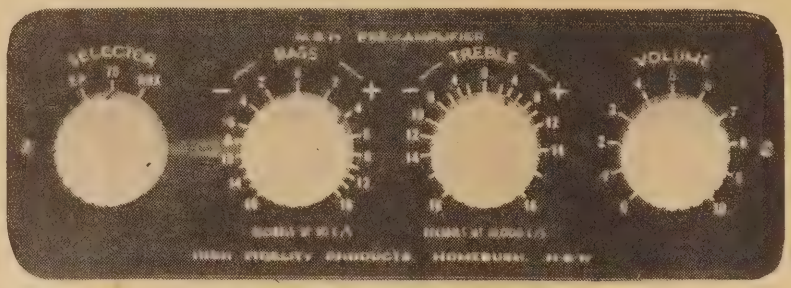


FIG. 6

M.B.H. Pre-amplifier

LABORATORY TESTED



It is very important that the units of a high fidelity music system should be matched. There are compromises in those pre-amplifiers designed to suit all types of pick-ups which preclude optimum results.

The M.B.H. PRE-AMPLIFIER TYPE 4 is designed to suit M.B.H. pick-ups. It has a selector switch, volume control and an auxiliary input. The extra wide range bass and treble controls are graduated in decibels from +16 to −16.

The use of 3 EF86 valves with heavy feedback gives the lowest distortion of any commercial pre-amplifier. The unit is easily attached to any existing main amplifier.

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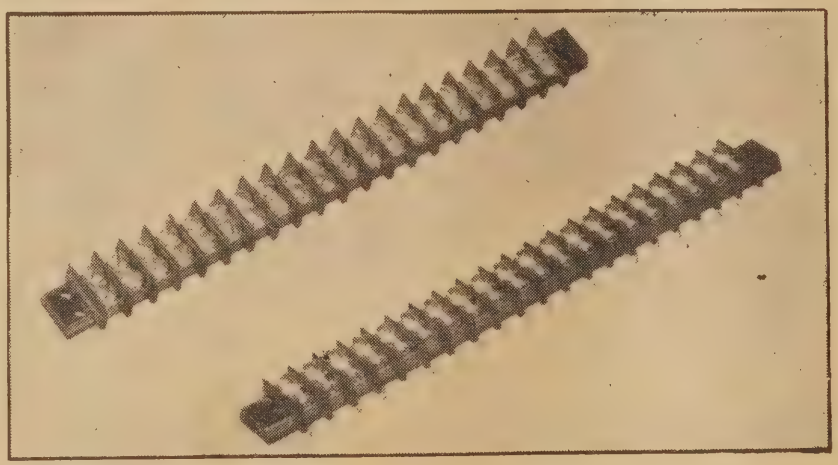

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ploying a power transistor, TR, as a shunt triode regulator. The base current (I1) of this transistor passes through the zener diode, D. The anode of this diode is connected to the positive DC OUTPUT terminal along with the collector of the transistor. Current I1 therefore is a function of the output voltage. Collector current, I2, flows in parallel with the external load current.

The current through diode D is adjusted such that this diode normally does not operate in its breakdown region. Current I1, therefore is quite low. If the output voltage rises, diode D passes heavy zener current into the base of transistor TR. This causes the transistor to draw heavy collector current, I2, and therefore to lower the output voltage by increasing the voltage drop across the current-limiting resistor. This is the mechanism whereby voltage regulation is obtained.

VOLTAGE RANGE

This scheme may be employed to regulate voltages up to 80 volts (depending upon the type of transistor employed) at currents of several amperes. The power supply may be of the semi-conductor type employing germanium, silicon, or selenium rectifiers.

Because of the current amplification factor of the transistor, base current I1 is small compared with collector current I2. Hence, diode D can be of the low-power type.

A heavier-duty, transistorised regulator circuit is shown in figure 6(B). Unlike figure 6(A), this is a series-type regulator. The two parallel- connected power transistors, TR1 and TR2, serve as a voltage-variable series resistor for regulating the output voltage.

The low-power transistor, TR3, samples the DC output voltage and alters the resistance of the TR1-TR2 combination to maintain the voltage at its proper level. The base of transistor TR3 is held at constant voltage developed by zener diode, D2.

In this application the diode is comparable with the gas-tube used as a voltage reference in tube-type voltage regulators, the TR1-TR2 transistor combination corresponds to the power-type resistance tube, and transistor TR3 is comparable with the DC amplifier ("voltage-sensing" feedback tube).

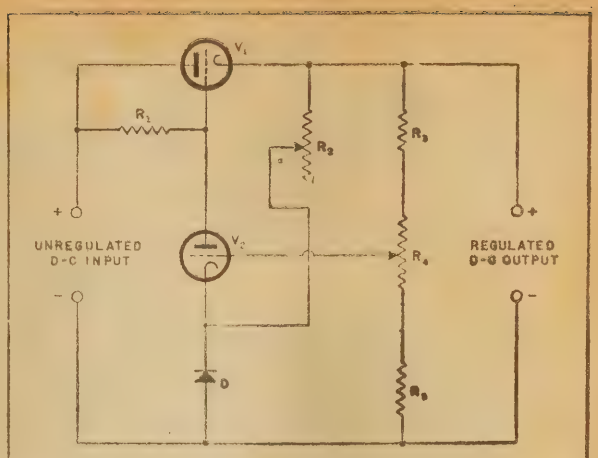
DIODE CURRENT

The zener current for diode D2 is obtained from transformer T (or a winding on the power transformer of the supply unit). D1 is a diode or semiconductor rectifier of the conventional type of conversion of the input voltage to DC. Filtering action is provided by resistors R3 and R4 and capacitor C. The current through diode D2 is limited by R3 and R4 to the maximum zener value which may be handled without exceeding the rated power dissipation of the diode.

Zener Reference Diode in Tube-Type Power Supply. A zener diode may be employed, in place of the usual gas tube, as the voltage reference device in a conventional voltage-regulated DC power supply. This substitution can result in a substantial saving of space, since the diode is many times smaller than the tube. Furthermore, the diode requires no socket.

Figure 7 shows such a connection in a conventional DC voltage regulator circuit. Here, the constant voltage drop across the zener diode, D, furnishes the voltage reference for the cathode of tube V2. Zener current through the diode is set initially by adjustment of rheostat D2, and the regulated DC output voltage is continuously variable by adjustment of potentiometer R4.

This regulator circuit is seen to be standard in every respect except the substitution of diode D for the usual gas tube.

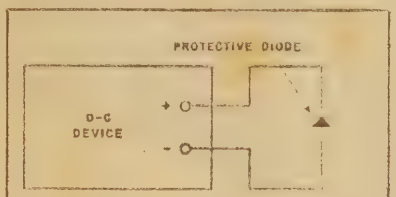


DIODE VOLTAGE REFERENCE IN TUBE-TYPE D-C POWER SUPPLY

FIG 7

Zener Diode as Protective Device. Figure 8 shows how a zener diode may be employed as an overload protective device for DC circuits and components.

The diode is connected across the DC terminals of the device to be protected. The polarity must be such that the diode



ZENER DIODE AS D-C PROTECTIVE DEVICE

FIG 8

is reverse-biased; that is, anode negative and cathode positive. Connected in this way, the diode resistance is many megohms and will not disturb operation of the device.

If the voltage of the device rises to the zener point the diode will conduct heavily, absorbing the extra current which otherwise would pass through and damage the device. The lowered resistance of the diode will reduce the device voltage if the DC supply is not regulated. When the voltage falls to a lower, safe value, the diode conduction comes out of the zener region and the diode resistance returns to its former high value.

The diode must be chosen for a zener voltage corresponding to the maximum voltage which may be applied safely to the device which is to be protected.

Some of the DC devices which may be protected in this manner include relays, lamps and other filaments, meters and recorders.

Continued on page 112)

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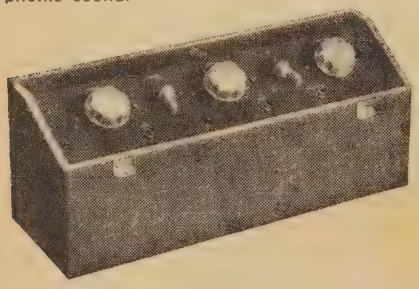

STERE-AD UNIT (£90/10/-)

Essentially the Stere-ad unit incorporates **two** matched pre-amplifiers (one of each track) together with a second 2½-watts power amplifier. Connecting the Stere-ad unit to the Ferrograph 3S completes the connections whereby the two pre-amplifiers and the two power amplifiers (one already in the Ferrograph and the other in the Stere-ad) automatically provide a 2 x 2½-watts matched stereophonic output for feeding into any appropriate external speaker system.

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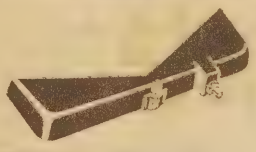

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This mechanical device permits the passage of the tape to be temporarily halted, during either recording or playback, without switching off the motor drive, thus facilitating omission of unwanted passages. Invaluable for editing purposes.

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The Ferrograph deck is now drilled with two holes to accept the Bib Tape Splicer. Greatly facilitates editing and repair of tapes by creating automatically a diagonal join which is virtually silent.

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The sloping panel case is an excellent housing for the VTVM, being small enough to use on the bench and presenting the meter face at a convenient angle. The label shown was improvised photographically, but we expect at least one manufatcurer to produce a complete etched panel.

Bench Type Vacuum-Tube Voltmeter

Here is an instrument which should have a very wide appeal to our more advanced readers. A VTVM embodying nearly all the features of our Senior VTVM, yet considerably smaller, simpler, and cheaper. If you want a bench type VTVM that is as easy to use as a multimeter, then this should be the job for you.

THE design is a natural outcome of the work we did last month in producing the improved version of the 1949 V.T.V.M. These improvements were so encouraging that, even before we wrote last month's article, we felt we should carry the idea to its logical conclusion and produce a completely new instrument, embodying these and as many additional improvements as possible.

Another inspiration was the Senior V.T.V.M. of January 1956. The operating convenience of this instrument, its constant zero, freedom of ambiguity of any kind, and all-round reliability has always impressed us, and we felt it was a worthy standard at which to aim.

At the same time, the type of instrument we had in mind was rather different. We felt that there exists a definite need for a reasonably compact V.T.V.M., such as may be used on the bench in the same manner as conventional multimeter; taking up no more room and needing — ideally — no more adjustment or attention.

It seemed that if we could embody most of the worthwhile features of the Senior V.T.V.M. in a sloping panel bench-type instrument and, at the same time, make a worthwhile reduction in circuit complexity and cost, we would have a meter with a very wide appeal. This, then, was our aim: A reasonably simple, moderate-cost instrument, which would be as easy to use as a multimeter.

In more precise terms, some of the features we wished to retain are as follows:

Two input terminals only. This may seem a small point, but having to select special terminals for routine measurements is just one more job to be done, and one more thing to remember. When working under pressure, it is bound to cause some annoyance.

Six voltage and resistance ranges. Anything less would either call for a special scale or make necessary awkward mental multiplication of the existing scales.

METER SCALE

We were further influenced in this regard by a desire to use the Senior V.T.V.M. scale. As well as being a clear and easy-to-read scale, it employs a skilful arrangement of ranges so as to permit even additions of 10 db to be made for each higher range — a very useful feature when making loss or gain measurements.

Elimination of the "Cal. Adjust." control was regarded as essential, as was the contact potential effect on the low AC ranges. A constantly changing zero is not only a source of annoyance, but can result in serious reading errors if the operator slips up on this adjustment, due to concentration on the job in hand.

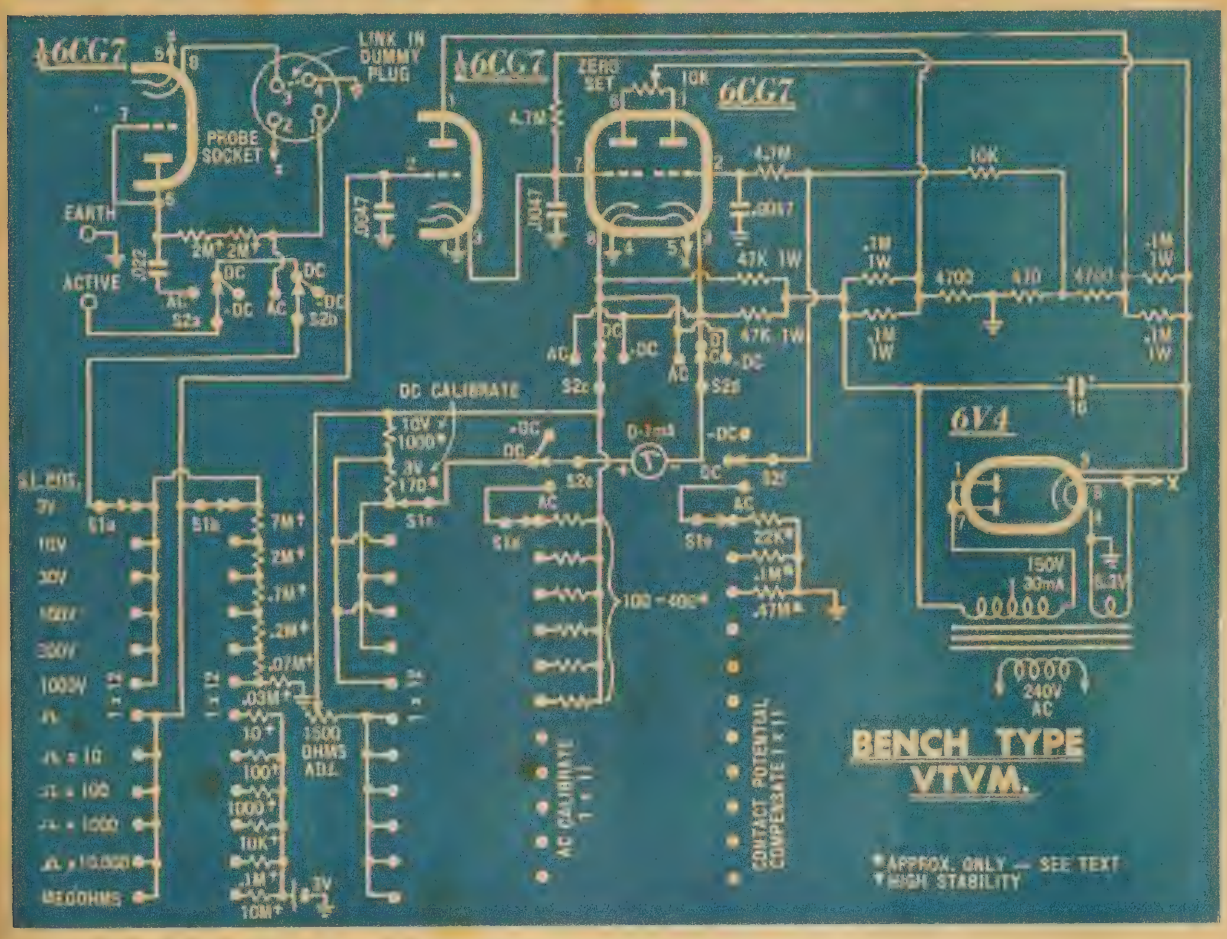
The ability to establish a center zero position is also desirable. This is mainly required when balancing an F.M. discriminator, and is a most useful feature.

We took as our basic circuit the arrangement developed for last month's article, i.e., one twin triode in a balanced bridge circuit, and a second twin triode as a cathode follower input stage and rectifier for the AC ranges. Once again it proved itself to be completely free from grid current effects or zero drift problems of any kind.

The only change was the substitution of miniature valves for the 6SN7. While the latter could still be used, we felt that the saving in space provided by the smaller types was worth while. We were further encouraged in this idea by the recent release of the 6CG7, which is virtually a 6SN7-GTA in miniature

by Philip Watson

NEW VTVM IS EFFICIENT, NOT UNDULY COMPLEX



The circuit incorporates most of the worthwhile features of the Senior VTVM, including the cathode follower in the input circuit and automatic compensation on all ranges, yet is comparatively simple. Note the simple half wave power supply.

Specially developed for TV circuitry, one of its features is cool grid operation to minimise grid current effects, making it a logical choice for our purpose.

Keeping the input terminals down to two was not particularly hard, though it did mean adding one more deck to the switch. Considering the convenience it provides, we consider it well worth while.

To provide the six voltage and resistance ranges we had the choice of either a six position range switch and a four position function switch, or a 12 position range switch and a three position function switch.

SLIGHT ADVANTAGE

There was not a great deal to it in terms of circuit complexity or the number of switch decks required, but we felt that the latter arrangement was more in keeping with the concept of being as easy to use as a multimeter. It means in effect, that a large percentage of the facilities are available at the setting of a single switch.

In the Senior V.T.V.M. the "Cal. Adjust." control was replaced by an extra switch bank and a series of potentiometers, one for each range. While an excellent scheme in most respects, it has the disadvantage that pots. are both bulky and expensive.

We decided to substitute fixed resistors for these pots. Admittedly this calls for some juggling of values during calibration, and will make this job a little longer, but we reasoned that most builders would be happy with the arrangement. As well as solving the space problem, it effects a worthwhile saving in cost.

We tackled the contact potential problem in a somewhat different manner. The Senior V.T.V.M. used an additional diode to balance the system, plus a switch bank to maintain matching resistance in the grid circuit of the passive half of the bridge.

We simply used the switch bank to vary a small positive "bucking" voltage previously applied to the passive grid. This voltage is desirable anyway to offset a similar voltage which appears at the cathode of the cathode follower, due to the inability of the cathode to "follow" the grid completely. Although this effect may be offset by the "Zero Set" control, the latter functions much more logically if the circuit is balanced as closely as possible within itself.

It also assists in obtaining a centre zero, and the value of balance pot. selected is such that it can be achieved on both the "DC" and "-DC" positions

The Senior V.T.V.M. scale provided slightly different length arcs for the 3 volt and 10 volt scales, in order to provide even 10 db increments for each range. To use it, it is necessary to alter the sensitivity of the meter between the 3 volt range (and multiples) and the 10 volt range (and multiples).

As with the Senior instrument, a switch bank is used to connect the meter alternately between two sensitivity controlling resistors. In this case the same bank brings the "Ohms Adj." pot. into circuit when the ohms ranges are selected.

TWO SWITCHES

We managed to perform all these functions, as well as several lesser ones associated with the "-DC, DC, AC" selection, using a four-section range switch and a two-section function switch Reference to the circuit will show how this is done.

The range switch (S1) consists of three 1 x 12 sections and one 2 x 11 section. This last section is really two switches on the one wafer, and makes for a saving in both space and cost. It is made

MASTER ELECTRICS PTY. LTD.

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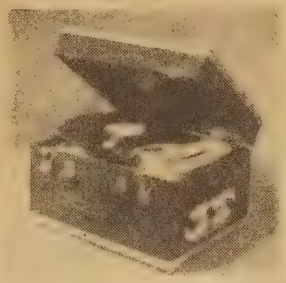

RECORD PLAYER AMPLIFIER

Very compact and lightweight. This unit combines a 4½ watt amplifier with two inputs one for the built-in 3-speed Philips record player and one for a crystal microphone. Each input has its own volume control. Also two outputs, and one for a separate extension speaker. Also an on-off switch and tone control is provided. The Cabinet is finished in two-toned leatherette. Ideal for parties or for playing records in the home. Well worth 35 gns. **Price only 27 gns.** 6in extension speaker in leatherette covered box worth £5. **Our price 69/6.** Crystal microphone to match this unit 45/.

4 speed Record Player in leatherette covered case with automatic stop, turnover head with crystal cartridge and 2 sapphire needles, plays standard and microgroove recordings. All colours available. Worth 19 gns. **Our Price £13/19/6 each.**

SPRING GRAMOTORS, wind-up type suitable for replacement in portable gramophones etc. Complete with turntable and fittings. **Price only £1/15/-.**

3 Speed Record Player Units consisting of motor and turnover head crystal pick-up, 2 sapphire needles, ideal for both standard and microgroove recordings, automatic stop. English make. **Price only £9/19/6 each.**

4-speed Gramo Motors to operate from 230 volt AC supply. Each has control knob with 16, 33, 45 and 78 R.P.M. positions and on-off switch. Ideal for playing all types of recordings. An excellent job, these are brand new and boxed. **Price only £5/10/.**

4-speed Record Player Units consist of motor and turnover head crystal pickup with 2 sapphire needles, ideal for playing microgroove and standard recordings. Automatic stop, English make. **Price only £10/19/6 each.**

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All parcels sent Registered Post unless otherwise stated. Postage or Freight must be included with order.

★ SPECIALS ★

1. 100 ma Power Transformer. 0-200, 240, 260 Primary. 385 Aside Secondary. 2-6.3 V 3amp. filament 1-5V 3amp. filament Brand new, vertical mounting. **Price 50/-.**
2. **0-5 ma Meters.** Brand new and boxed made in England 2in Scale, Square front. **Price 25/- each.**
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4. **Zero Centre Ammeter** D.C. 3½ inches diameter, 30-030 amps. Moving Coil. Brand new and boxed. Worth £4/10/. **Our price 30/- each.**
5. **Few only 400 Volt amp. Auto Transformers.** 230 volt to 110 volt at 50 C.P.S. Ideal for adapting 110 volt equipment to operate off 230 volts A.C. mains. Made in U.S.A. Brand new and boxed. Worth £21/10/-. **Our Price £5 ea.**
6. **Germanium Diodes.** English make, brand new and perfect. Ideal for use as crystal detectors, rectifiers, etc., in radio and TV receivers. **Price only 3/11 each.**
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OC44	£1 18
OC45	£1 16 7
OC71	£1 7 1
OC72	£1 13 3
20C 72	£3 6/6
OA70	7/ ea.
20A72	17/6 pr.
20A79	17/6 pr.
OA85	10/11 ea

8. **Philips Germanium Diodes.**
9. **80 ma Power Transformers.** 230 volts Input. Secondary 385 Volts aside. Filaments 2.5 volts at 5 amps. Filaments 5 volts at 2 amps. Filaments 6.3 volts tapped at 4 volts at 3 amps. Brand new and boxed. Worth £3/15/-. **Our price £1/19/6**
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11. Twin Rubber covered leads with phone plug attached. **Only 2/ each.**
12. **Gramo Pick-Ups.** Excellent quality turnover head crystal type with two Sapphire stylus. Worth £5/15/-. **Our price £2/15/-.**

★ SPECIALS ★

13. **Magnetic Pick-Ups.** English make with bakelite arm for 78 R.P.M. records. Light weight. **Price only 7/6 each.**
14. **Sound Boxes** for acoustic gramophones. **Price 7/6 each.**
15. Tone arms for acoustic gramophones finished in ivory. **Only 6/ each.**
16. Carbon Pots,
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17. Carbon Pots with Double Pole Switch. 1 meg **6/- each.**
18. .25 mfd. 1500 volts DC test, Block Condensers. **9d. each.**
19. 2X.1 mfd. as above. **1/- each.**
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    Type CV35 — 3 Plate 15 P.F. **3/9**
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    The above are the single bearing type and not suitable for ganging.
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CV41	2 Plate	10PF	7/
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possible by the fact that the functions it performs (AC Calibrate and Contact Potential Compensate) only apply to the AC ranges, so that less than the full 12 contacts are required.

The switch is a "special" only in the sense that the combination of wafers is not a standard one. However, the wafers themselves are quite standard, and no difficulty should be experienced in obtaining this within a few days of placing the order. Spacing between the wafers is three-eighth inch except the last two, where half inch is recommended. Overall length of the switch from panel to rear wafer is 2¼in approx.

The first section, S1a, directs the input circuit either to the voltage divider network or the ohm meter resistance network, and is a comparatively simple function.

S1b is directly in the grid circuit of the cathode follower, and selects each of the voltage divider tappings and ohm meter standard resistors as required.

DC CALIBRATION

S1c selects the 3 volt and 10 volt calibration resistors alternately as required throughout the voltage ranges, and the "Ohms Adj." pot. for the ohms ranges.

S1d selects the individual calibration resistors for each AC range, and S1e selects the contact potential compensation resistors for as many ranges as may be required.

The function switch (S2) consists of two 3 x 3 sections. S2a and S2b direct the input circuit either to the rectifier diode (for AC) or direct to the voltage divider network for DC. S2c and S2d constitute the meter reversing switch for the "DC" and "AC" positions.

S2e switches the meter between the DC and AC calibrating resistance networks, while S2f brings the contact potential network into circuit for the AC ranges only.

Another saving in space and cost was achieved by the use of a 150 volt, 30 mA power transformer. By ignoring the centre tap and using it as a 300 volt half-wave transformer, we were able to obtain all the voltage we needed from the smallest and cheapest transformer available. Since this is running at about two-thirds its maximum rating, it is doubtful whether anything much better could be obtained, even if made to order

CONSTRUCTION

Coming to the construction of the instrument, there are quite a few points to be considered. Even with the space saving selection of components already described, there was not a great deal of space to spare in a sloping panel case The layout we finally adopted is not unduly critical in the physical sense, but it is necessarily fairly compact. For this reason, construction should be carried out in logical order if awkward problems are to be avoided.

Fairly obviously, lead length and component placement are not critical in an instrument of this kind, in the electrical sense, but the best placement often makes the actual construction a good deal easier. Our layout recommendations are based mainly on this fact.

The chassis is in the form of a shelf, 4⅝ x 6½in, supported on the front panel. The depth (4⅝in) could be increased by about one inch, but there is little to be gained since there would be very little useful room either above or below it.

Construction is best divided into two sections. The first covers the meter circuitry proper, i.e., the power supply, bridge circuit, cathode follower, AC diode, etc., built up to the stage where preliminary testing may be conducted and any minor errors corrected before proceeding further.

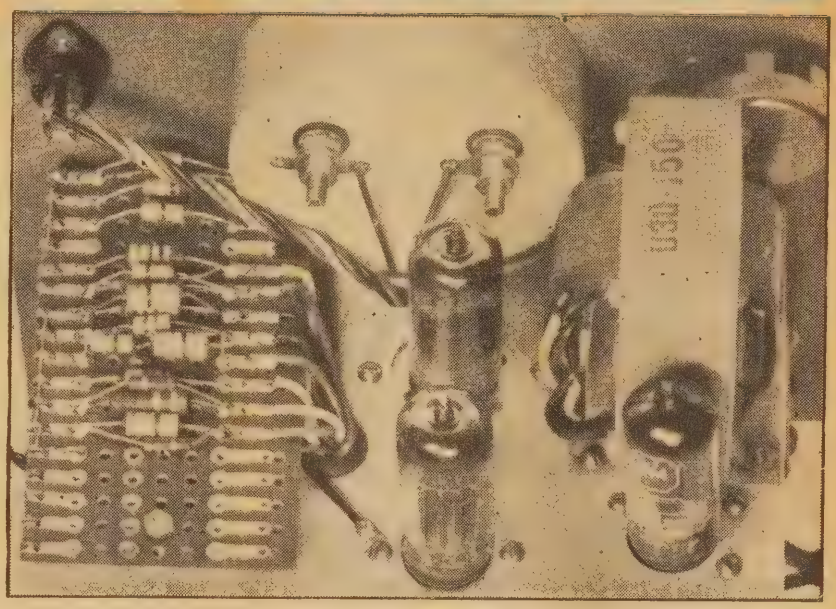
The second section covers the switching, voltage and ohms resistance network, compensation and calibration networks, etc. Although there is a lot of wiring associated with this portion, most of it is simple and quite logical.

Most of the power supply components are mounted on an eight tag terminal strip almost directly under the function switch (Fit this strip before fitting the power transformer.). These include the 16 mfd filter capacitor and most of the centre tapped voltage divider network. However, the 470 ohm and 4,700 ohm resistors on the positive side are mounted on a separate tag strip beneath and to one side of the range switch. This also supports the 10K and 4.7M resistors in the grid (pin 2) circuit of the bridge valve.

This should be a five tag strip, and must be so mounted as to clear the adjacent 7/16in cable hole. The only other terminal strip is a three tag type adjacent to the rectifier socket, which terminates the incoming power cord.

The bridge valve is at centre rear of the chassis, with the cathode follower/AC diode almost exactly in the centre of the chassis. The bridge valve is orientated with the pin gap remote from the 6V4 socket, while the other 6CG7 has the gap towards the front panel.

TOP VIEW OF VTVM CHASSIS



The two 6CG7's are in the centre of the chassis, the bridge valve nearest the camera. The resistor panel on the left supports the various calibration and compensation resistors. (See panel below). Pot. on the right is "Zero Set" control.

ABOVE-CHASSIS RESISTOR PANEL

The resistors on the terminal board in the picture above are in the following order, commencing at the front panel:

The contact potential compensation resistors for the 3, 10, and 30 volt AC ranges in that order, with space for a fourth (100 volt range) if it should appear to be necessary.

The 3 volt and 10 volt DC calibration resistors (Connected in series for the 3 volt position).

The AC calibration resistors starting with the 3 volt range and finishing with the 1,000 volt range nearest the camera.

Note that many values require two resistors, either in parallel or series.

FIRST CHECK

Wire up as much as possible of the circuit without involving any of the switch functions. Provide a pair of temporary leads from the bridge valve cathodes (pins 3 and 8) to connect to a meter, and connect a 10M resistor temporarily between the grid of the cathode follower (pin 2) and chassis.

Rather than use the new 1 mA. meter movement at this stage, we suggest that a multimeter be connected in its place and set to one of the higher current ranges. Thus, in the event that there is a circuit defect causing severe unbalance, no damage will be done. When an approximate balance has been achieved on the high range the meter sensitivity may be increased to 1 mA. and the balance checked again.

The meter should zero with the balance pot approximately in the mid position. If the system is grossly out of balance, check carefully the resistors in the power supply voltage divider, the two 47Ks in the cathode circuit, and the two 4.7Ms in the grid circuits. Ordinary 10 per cent tolerance types are quite satisfactory in these positions, but one with an incorrect "dot" colour, or even open circuit, can play havoc with the bridge balance.

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where our policy of stocking only top quality components at a reasonable price will not only be maintained but extended.

We tender a cordial invitation to all Radio Dealers, Servicemen, Hams, Hobbyists, and the General Public to visit us at our new Sales location, with the assurance of an active interest in all your requirements.

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If the system balances, or nearly so, but the balance pot. needs to be set markedly towards one end or the other it may be necessary to vary the 470 ohm resistor in the power supply divider network. This provides the small bucking voltage mentioned earlier and can be varied slightly to secure the best possible balance.

As a final check a 1000 ohm resistor may be connected in series with the 1 mA meter, and small valves of battery voltage applied to the grid (pin 2) of the cathode follower. Approximately three volts should be sufficient to provide full-scale deflection.

If this test is passed the function switch (2 x 3 x 3) may be mounted and wired as far as possible. However, it is a good idea to complete as much of the wiring on the switch as possible before actually mounting it, and to attach short lengths of hook-up wire to those contacts which may be hard to reach when it is mounted.

SWITCH ARRANGEMENT

The exact decks chosen for a particular function are not critical, but it is a good idea to use the corresponding switches on each section for S2a and S2b, and S2c and S2d. This much completed, the unit may be tested again to make sure that the meter functions correctly on all three positions, and does actually reverse.

Next, make sure that all connections to the cathode follower/diode valve are completed or that flying leads are connected to the pins where this is not possible. Once the range switch goes into position this socket is partly obscured.

As with the previous switch, as much wiring as possible should be done before it is mounted, particularly on that side nearest the chassis. Where flying leads are fitted these should be colour coded for easy identification.

The beneral orientation of the switch may be seen from the photograph, but we suggest that the common arm be located nearest the function switch for most convenient wiring.

The switch should now be rotated anti-clockwise until the stop is encountered, this corresponding to the 3-volt position (12 o'clock on the label). Clockwise rotation from this point will then progress through the voltage and ohms ranges in the order shown in the circuit, the stop being encountered again at the "Megohms" position.

KNOB CHECK

It is a good idea to get these positions clearly established before wiring is commenced, and with a knob and label in position. Then the knob may be rotated to each position as it is wired as a positive check that the appropriate contact is, in fact, being wired.

The order in which the decks are used is not particularly critical, but that used in the circuit, with SIa nearest the front panel is about the most logical. Much of the wiring of SId and SIc may be completed after the switch is mounted.

When mounting these two switches, and the pots., we suggest that a spare nut or suitable washers be used to space them as far away from the panel as possible. This prevents excessive thread from appearing on the front of the panel, and allows the knobs to fit closer to the panel.

Next comes the mounting of the various range resistors; the input voltage divider, the ohms standards, and the calibration and compensation resistors. Because of the large number of resistors involved we needed something more compact than the conventional terminal strips or terminal panels.

A form of panel known as matrix board appeared to be a better proposition, mainly because of the close spacing of the mounting holes and the extreme flexibility with which it may be built up into any form of terminal panel.

It is supplied as a punched board in a variety of sizes, together with terminal lugs with rivets attached. These are quickly and easily fitted with almost any kind of improvised rivet punch and a ball-pein hammer.

The board we used — which happened to be on hand — was nine holes wide, but we used only six holes of width, and this is quite adequate. Six hole width is a standard size, and would be easier to fit as well as a little cheaper. Two panels are required, both most conveniently 17 holes (4¼in) long, together with the appropriate number of terminal lugs.

One mounts below the chassis and one above, the same pair of screws (¼in Whit. x 1in R.H.) supporting both about half an inch away from the chassis. The lower panel supports the voltage and ohms range resistors, and the upper one the calibration and compensation resistors.

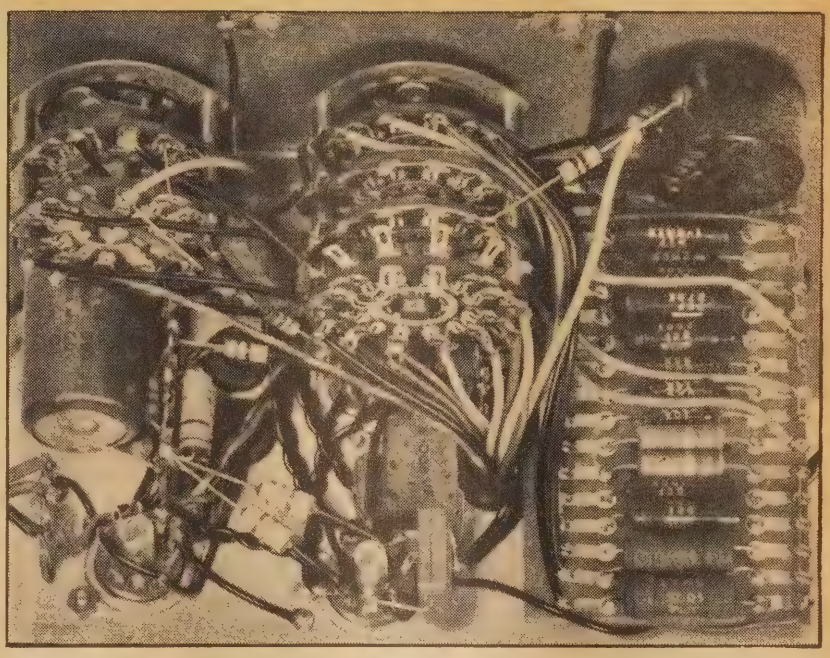
This arrangement is most convenient, because it allows the instrument to sit right way up while the calibration resistors are being selected on a trial and error basis. We will have more to say on the actual method of selection later on. As can be seen from the photograph, we fitted an extra row of plain rivets in this board, to simplify the connection of resistors in series where this might be necessary.

RESISTOR MOUNTING

The mounting of the high stability resistors on the lower panel may vary somewhat from our arrangement, depending on the number of resistors necessary to make up the specified values, and whether they can be supplied in half watt or one watt sizes. Since we had to use a number of one watt types where half watt types would have done, and combinations in place of single resistors, it is unlikely that the home builder will strike any worse conditions. More likely he will be better off.

The spacing between the terminal lugs is rather too small for the one watt types, but this is easily overcome by raising each alternate one slightly above its neighbours. Note that we used some wire wound types and ordinary carbon types for some of the ohms standards, these being all that were available at

UNDERNEATH VIEW OF CHASSIS



The socket on the extreme left is the rectifier and the one in the centre nearest camera the bridge valve. Note the two 47K cathode resistors running direct to negative terminal of power supply. Resistor panel on the right supports th voltage and ohms range standard resistors. The resistor in series with the "Ohms Adj." pot is not necessary if a 1,500 ohm pot. is used.

UNDER-CHASSIS RESISTOR PANEL

The resistors on the terminal board in the picture above are in the follwing order, commencing at the front panel:

Two 2.7M (under the "ohms" pot.) and a 1.6M to make 7M.

One 2M. One 430K and 270K (.7M), one 200K one 56K and 14K (70K), and one 30K. This completes the voltage divider network.

The two carbon resistors are 5M each (to make 10M) followed by 100K, 10K, 1K (Obscured by 10K), 100 ohms and 10 ohms. These are the ohms range standards

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Linear single output, full fidelity, tapped, 5 watts, **£2/19/6,** plus tax.

Instrument Transformer, 240 A.C., 150V 15 mills, 4 and 6 volts, 2amps **£1/19/6,** plus tax.

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£4/19/6, plus tax 12½%.

Oscilloscope, R. and H. type tube shield, 5 B.P.I.

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Standard Instrument Cases. Finish Grey.

Cat. No.	Long	High	Deep	Prices, plus 12½% S.T.
MC6	6	6	6	11 9
MC7	10	8	7	17 10
MC67	12	7	6	19 9
MC81	10	10	8	1 3 6
MC811	12	11	8	1 8 3
MC79	15	9	7	1 11 0

Sloping Front Cases

SF7	7½	6½	6	15 3
SF79	9½	6½	7¼	19 6
SF71	11	6½	7½	1 2 0
SF8	13	8	8½	1 6 6
SF10	18	10	10	2 1 0

R. & H. type Cabinets, finish Hammerdock, louvred sides, welded corners. Plus tax, 12½%.

MC5A	9	6⅝	5½	18 9
MC82A	13	8	6⅞	1 12 3
MC87A	15	10	8	2 2 0

Sloping Front for Multimeter.

SF7A	7½	7¼	7¼	1 1 0

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short notice. The wire wound types are quite good, but we intend to replace the carbon types as soon as possible.

Leads connecting to the upper panel are brought through the grommeted 7/16in hole near the range switch. Colour coded wires are really essential here, and we managed to provide most of the colours of the Standard Colour Code. Used in their correct order, they helped considerably in remembering which wire was which without continual reference to the other side of the chassis.

Another grommeted hole behind the meter barrel accommodates the meter leads, as well as the leads to the probe socket on the front panel. We hope to have more to say about probes in a later issue and, in the meantime, it is only necessary to provide the dummy plug with shorting link as shown in the circuit.

A detailed description of the calibration procedure will have to wait until next month but, for those who feel competant to go ahead on their own, the following points should be noted:

About five minutes may be necessary to allow the instrument to settle down after first switching on. DC calibration is mainly a matter of selecting the two sensitivity resistors for the 3 volt/ 10 volt relationship, after which the accuracy will be determined by the resistors in the divider network.

Each AC range must be calibrated individually, and the AC ranges concerned will need to be at least approximately correct before the contact potential compensation resistors are selected. No standard is required for the latter operation, it merely being necessary to bring the meter back to zero on those ranges effected. This will normally be the three lower ones, but the fourth also may be compensated if the error is objectionable.

No adjustment should be necessary for the ohms ranges, but a selection of resistors designed to give a centre reading on each range will enable these to be checked. The accuracy is mainly determined by the accuracy of the standard resistors.

The ohms battery is a 3 volt cycle lamp battery (Type 701 or similar) and is mounted in the front right corner of the case, with the negative contact uppermost and the positive contact toward the rear. (It actually sits beneath the "Ohms Adj." pot.) It is held in place by a simple aluminium strap and the leads are soldered to the contacts. Replacement should only be required at infrequent intervals.

A fair amount of heat is generated in the case, and we found it necessary to drill a row of 3/8in holes (about 10) along the top rear and a similar row

(Continued on Page 112)

A reproduction of the meter scale. Note the differing length of the 3 volt and 10 volt scales to allow even additions to the Db scale.

PARTS LIST

1 sloping panel instrument case 7½in x 7¼in x 7¼in.
1 Metal panel or etched label to suit.
1 Chassis shelf 4 5/8in x 6½in
1 0-1 mA meter. 100 ohms. Senior VTVM Scale.
1 Power transformer 150/150V. 30 mA. 6.3V 2A
1 2 section switch, each section 3 x 3. 4 section switch, 1st, 2nd, 3rd sections 1 x 12, 4th section 2 x 11. 3/8in spacing between 1 x 12 sections.
2 6CG7 valves.
1 6V4 valve.
1 Min. 4 pin speaker plug and socket.
3 Min. 9 pin sockets. (Mica filled).

CAPACITORS

1 16 mfd. 500VW.
3 .0047 mfd. mica or plastic.
1 .022 mfd. mica or plastic.

RESISTORS 10% types.

2 4.7M ½W.
4 .1M 1W.
2 47K 1W.
1 10K pot.
1 10K ½W.
2 4700 ½W.
1 1500 pot.
1 470 ½W.

N.B. Calibration and compensation resistors are not included in above, due to difficulty of specifying exact values.

HIGH STABILITY TYPES

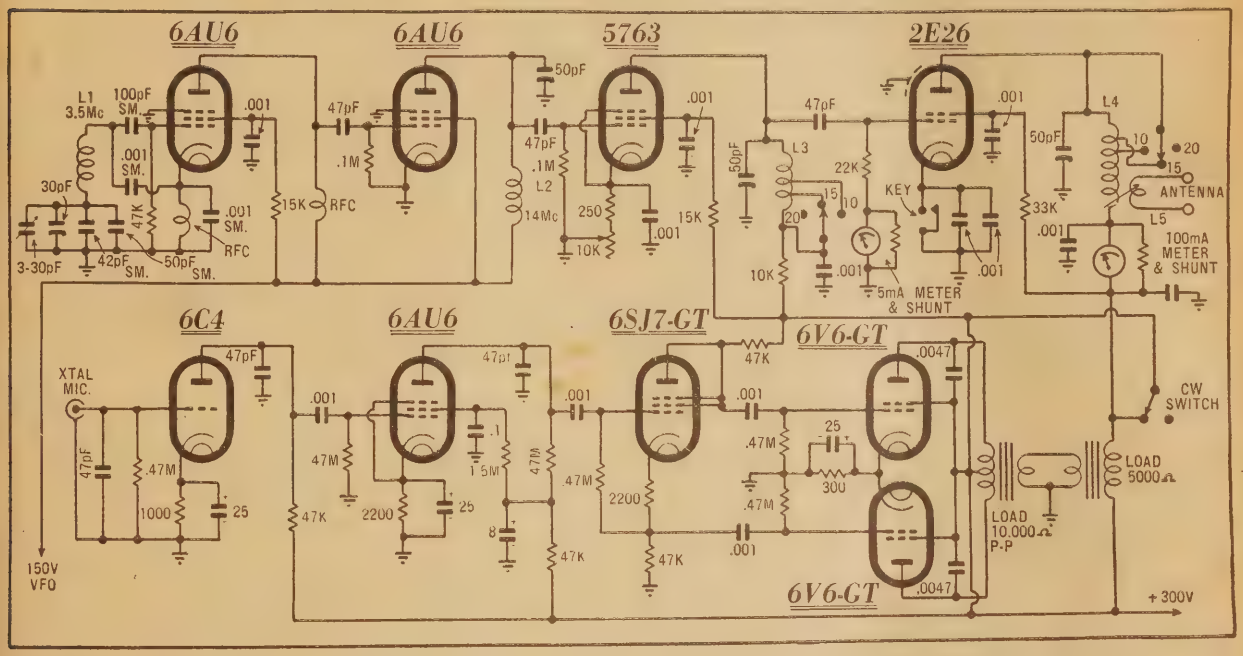
1 7M (made from not less than two approx. equal ½W types).
1 4M (1.8M plus 2.2M ½W).
1 2M ½W.
1 .7M ½W.
1 .2M ½W.
1 .07M ½W.
1 .03M ½W.
1 10 ohm wire wound.
1 100 ohm high stab. or WW.
1 1000 ohm ½W.
1 10K ½W.
1 .1M ½W.
1 10M ½W.
1 3 volt cycle lamp battery (701 or similar).

Approximately 9in 6 hole wide matrix board with lugs, rivets, etc.
1 8 tag terminal strip.
1 5 tag terminal strip.
1 3 tag terminal strip.
Hookup wire in range of colours.
3 pointer knobs.
2 terminals (1 red, 1 black).
2 1in x 1/8in Whit. R.H. brass screws
4 3/8in grommets.

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

DESIGN FOR A HIGH FREQUENCY AMATEUR TRANSMITTER



Although not many of our transmitting amateur readers are prepared to copy designs exactly they do appreciate information on existing designs as a source of ideas which can be considered for their own "rig." You may find something in the above circuit which will be adaptable to your station.

A READER from Frankston, Vic., forwards some details of a small transmitter which he put into operation some months ago. It is mainly intended for operation on the 10, 15 and 20 metre bands and employs a VFO so that the frequency of the transmission may be varied either to net with another station or to avoid interference

Power supply for the VFO in the original transmitter was obtained from a separate transformer, rectifier and filter arrangement and the receiver power supply used to provide 250 volts for the rest of the transmitter. Any one of a number of arrangements could be made here depending on the power supply which happens to be available. However, if a common power supply is used to power the entire transmitter it would be a good idea to use a voltage regulator tube to maintain the supply to the VFO free of any trace of audio.

STABILITY

VFO stability naturally depends on the quality of the components used in the frequency determining circuits and the care taken with the mechanical assembly. Our correspondent assures us that the original VFO is very good from the stability He does not suggest the use of negative temperature coefficient capacitors, but these could be added if necessary (See amateur mobile transmitter, October, 1958.)

Valve type 6AH6 could be used in place of the 6AU6 and may give more drive Apparently there is plenty with the 6AU6s.

The suggestion for using ordinary speaker transformers back-to-back in place of a conventional modulation transformer will appeal to amateurs who would like to save on the cost of a conventional modulation transformer. Efficiency will be lower than normal but this will not be important when there is power to spare.

COIL INFORMATION

L1 26 turns 22 gauge on 5/8in former

L2 18 turns 22 gauge on ¾in former spaced ¾in.

L3 13 turns 18 gauge air wound at ¾in diam., spaced 1¼in, tapped 4 and 7 turns from HT end.

L4 13 turns 16 gauge 1 3-8in diam, air wound, spaced 1¼in, tapped 3 and 7 turns from plate end.

L5 3 turns 18 gauge covered with spaghetti and slipped in HT end of L4

TEST PROD FROM BALL POINT

MR E. C. JACOBI, of Dalby, Queensland, writes, "Maybe this will help someone; quite often we break a test prod and it always happens right in the middle of a busy period.

"Last time it happened to me, I had no spare prods but looking along the work bench, I happened to notice a ball-point pen which gave me an idea.

"I ground off the ball point. Then I soldered an old gramophone needle into the position originally occupied by the ball. I cut the end off the barrel of the pen, inserted the wire and soldered it to the brass tip.

"I now have two new test prods which have already given good account of themselves."

WIDER ANGLE PICTURE PRESENTATION AND MULLARD

With the introduction to the Australian market of television receivers employing picture display on 110° deflection television tubes, a number of technical problems, associated in the main with scanning circuits and E.H.T. generation, present themselves to the Design Engineer. These problems are in addition to the electron-optic design requirements for wider angle picture tubes and of course, due to the more arduous operating conditions in line and frame output stages, the production of associated valves with peak voltage and current ratings suited to the task. All these factors must be achieved whilst maintaining the high degree of performance and reliability we have come to expect in television receivers with narrower deflection angles and we believe Mullard valves, semiconductor rectifiers and radiant screen picture tubes, the abridged data for which appears opposite, fully meet these requirements.

Analysis of this data reveals that the 6CM5/EL36 and 1S2/DY86 cope nicely with the more stringent requirements of 110° deflection systems, whilst a new low impedance pentode the 6CW5/EL86 is available for frame output service.

In some line output circuit designs the 6R3/EY81 booster diode will have adequate ratings, but where it becomes necessary for the diode tap to be higher up the transformer a new valve with improved peak voltage ratings, the 6AL3/EY189 may be preferred.

The higher volt-ampere requirements of 110° scanning yokes implies increased power input to the scanning generators of a television receiver, and this in turn necessitates further evaluation of the mains rectifier system. Recent advances in semi-conductor manufacture have resulted in silicon junction rectifiers of suitable rating becoming an economic solution to this problem, and the OA210 with a peak inverse rating of 400 volts is intended for mains rectification in a voltage doubling circuit.

With the 6CW5/EL86 replacing the pentode section of the 6BM8/ECL82 for frame output service a triode valve section is lost, and if we are to maintain the same circuit configurations which have been used in narrower angle receivers, a triode valve section must be added elsewhere in the receiver valve line up. This is accomplished in the 6DX8/ECL84 which is a video pentode with a higher figure of merit than the 6CK6/EL83, together with a triode section having a mu of 65.

The picture would not be complete without mentioning the AW53-88 and the AW43-88 which are 110° radiant screen television tubes with compatible electron-optical systems. This feature, together with the close adherence of other ratings, enables common yoke and line output transformer design for both 21 in. and 17 in. 110° receivers—a factor of which we are sure the industry will approve. Comprehensive data on all Mullard valve types is available through the Technical Service Department and Design Engineers are invited to discuss their problems with the Engineers of our Applications Laboratory.

MULLARD VALVES AND RADIANT SCREEN TELEVISION TUBES FOR WIDER ANGLE PICTURE PRESENTATION

TYPE	DESCRIPTION	HEATER	Va	Vg_2	$-Vg_1$	Ia(mA)	Ig_2(mA)	μ	gm(mA/V)	REMARKS
1S2	Half-wave Rectifier for E.H.T. service.	1.4V	P.I.V. 22kV	—	—	0.8 max.	—	—	—	Data for typical television service. C max. 2000 pf.
6AL3	Booster Diode for line output stage	6.3V	Peak 6kV	—	—	Peak 550.0	—	—	—	Peak Heater-cathode rating 6.6kV. Ia max. 175mA.
6CM5	Power Output Pentode for line deflection service	6.3V	220	160	—	90.0	38.0	—	11.0	Data for typical television service. Peak anode voltage 7kV, Ik 200mA (max.). It is recommended that designers consult the nomogram for the value of peak anode current at the knee voltage for a particular value of screen grid current.
6CW5	Low Impedance Power Output Pentode for frame deflection service	6.3V	220	180	—	56.0	6.0	—	10.0	Data for typical television service. It is recommended that designers consult the nomogram to determine the peak anode current at the knee voltage for a particular screen grid potential.
6DX8	High-Mu Triode	6.3V	200	—	1.7	3.0	—	65	4.0	Suitable for synchronising and A.G.C. circuits.
	Video Output Pentode		220	220	3.4	18.0	3.1	36 (g_1 — g_2)	10.0	C_{out} 4.5pf, C_{in} 9.0pf, C_{a-g1} 0.1pf.
OA210	Silicon Junction Diode for 127V rectifier service	—	127V (RMS)	—	—	5.0A pk. 0.5A (averaged over 50ms)	—	—	—	P.I.V. 400V, Inverse Current at P.I.V. = 45μA. Recommended for voltage doubler applications with mains transformers having 127V secondary.

TYPE	DESCRIPTION	FOCUS	SCREEN	HEATER	—Vg	Va_1	Va_3 (Focus-electrode	Va_{2+4}
AW53-88	21 in. screen, 110° Deflection Angle.	Electrostatic (straight gun)	Metal backed (no ion trap)	6.3V, 300mA	30—72 (for visual cut off)	300V	0–400V	16kV
AW43-88	17 in. screen, 110° Deflection Angle.	Electrostatic (straight gun)	Metal backed (no ion trap)	6.3V, 300mA	30—72 (for visual cut off)	300V	0–400V	16kV

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A COURSE IN TELEVISION

Part 33 — SAWTOOTH OSCILLATOR (Cont.)

The blocking oscillator and multivibrator type of line oscillator are distinguished by the fact that their exact frequency can be varied, either manually or automatically, by varying the DC voltage applied to one of their active electrodes. With a sine wave oscillator, as discussed in this article, it is necessary to interpose a reactance control tube to facilitate variations in DC potential into changes in frequency.

THE operating principles of a reactance tube were explained in some detail in the last issue. In brief, a reactance control tube usually takes the form of a high Gm pentode, with its plate circuit connected across the oscillator tuned circuit, whose frequency is to be controlled.

Some of the oscillatory voltage appearing across the tuned circuit is diverted to an input electrode of the control valve through a network designed deliberately to shift the phase of the signal by 90 degrees. This produces an out-of-phase component of plate current, whose magnitude is dependant largely on the valve's transconductance.

To the tuned circuit, the valve plate looks like a device in which the current flow is 90 degrees out-of-phase with the applied voltage — therefore either a capacitor or an inductor, according to whether current leads or lags the voltage. Its presence in the circuit modifies the natural resonant frequency just as if it were, in fact, an actual shunt capacitor or inductor.

LOWERS FREQUENCY

Additional shunt capacitance tends to lower the resonant frequency, shunt inductance to increase it.

The order of this apparent shunt component can be varied by modifying the transconductance of the control valve by means of a DC potential applied to one of its electrodes. It is thus possible to apply a DC control voltage to the grid of the reactance tube and have it vary the resonant frequency of a tuned circuit and the operating frequency of the associated oscillator.

Figure 181 shows the complete line oscillator circuit from an American commercial receiver, actually one dating back a few years.

Heart of the circuit is a 6K6 pentode functioning as a cathode tapped Hartley oscillator, tuned to the nominal line frequency — in this case 15,750cps. Cathode, grid and screen provide the basic oscillator electrodes, oscillator energy appearing in the plate circuit by electron coupling action.

The waveform, already distorted at the plate, is differentiated by a small following coupling capacitor and resistor to become sharp spikes, having a repetition rate equal to the nominal line frequency. These are used to trigger a separate 6SN7-GT discharge tube, controlling the actual sawtooth generating network.

Positive excursions of the differentiated voltage cause grid current to flow charging the .01mfd coupling capacitor. The order of the charge is such that the grid is maintained beyond cut-off except during the actual positive signal peaks. As a result, plate current is cut off for most of the time, flowing in an abrupt burst each time the grid is driven positive.

While the plate current is cut off, the 680pF capacitor charges toward the HT supply voltage through the two plate resistors. It is rapidly discharged each time the valve conducts.

SAWTOOTH VOLTAGE

A sawtooth voltage is therefore generated at the plate of the discharge valve, in much the same way as described for earlier circuits.

Basically, the operating frequency of the 6K6-GT oscillator is determined by a number of components which together constitute a resonant grid-cathode circuit. These include:

(1) The actual grid-cathode coil, A-B-C.

(2) A secondary winding D-E-F coupled to it and shunted by a .015mfd capacitor. Purpose of this winding will be discussed later but it must obviously contribute to the ultimate resonant frequency.

(3) Two capacitors (.0012 and .015 mfd) connected in parallel and wired between grid and earth, in series with a 10-ohm resistor.

Voltage developed across the 10-ohm resistor is fed to the cathode of the 6AC7 which, for the purpose, functions as a grounded-grid amplifier stage. Signal voltage applied to the cathode has the reverse effect on plate current to a similar signal applied to the grid, a positive-going cathode signal being equivalent to a negative-going grid signal.

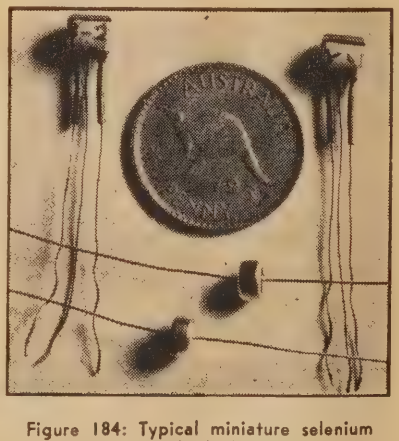

Figure 184: Typical miniature selenium rectifiers, currently finding wide usage in Australian television receivers. The "push-pull" types at the top are used in synch. discriminator circuits, replacing the 6AL5. The miniature bead types could also be used but find more application as AGC diodes, their non-linearity below 1 volt providing "free" AGC delay.

This being so, the quadrature voltage developed across the components interconnecting the tuned circuit and the 6AC7 plate and cathode has the reverse effect on frequency to what would happen if the quadrature voltage were fed to a grid.

According to manufacturers data on the circuit, a positive shift in control voltage on the grid of the 6AC7 INCREASES the oscillator frequency, while a negative shift DECREASES it.

The control voltage comes, as before, from a twin-diode synch. discriminator, differing in detail from the one described last month for the multivibrator type of line oscillator.

Since a resonant tuned circuit is available with a Hartley oscillator, it is simple and convenient to provide a centre-tapped winding coupled to it (winding D-E-F) which will deliver to the diodes two sinoidal voltages at line frequency, balanced in amplitude but 180 degrees out-of-phase.

The incoming synch. voltage can be superimposed on these for purposes of comparison by feeding it into the centre tap of the winding D-E-F.

Figure 182 illustrates the resultant voltages present at the two diode plates. Note that the oscillator voltages are shown as out-of-phase while the synch. pulses superimposed upon it have the same phase.

IDEAL CONDITION

In the idealised condition, with the oscillator naturally and exactly resonant at the line frequency, individual line synch. pulses occur half-way up the slope of the reference sine waves. At this instant, in fact, the instantaneous voltage of the sine wave is zero and the peak signal amplitude is purely proportional to the synch pulse amplitude.

The resultant signal at the two diode plates is equal, the same conduction current flows and the same voltage is developed across the separate cathode load resistors. Since the circuit is symmetrical, it follows that the two cathodes must assume the same potential, whatever it happens to be.

In actual fact, the circuit design provides for a bias of minus 2 volts to be applied externally to one cathode so that, in the balanced condition, the same negative potential must appear at the other.

HARTLEY LINE OSCILLATOR WITH REACTANCE TUBE

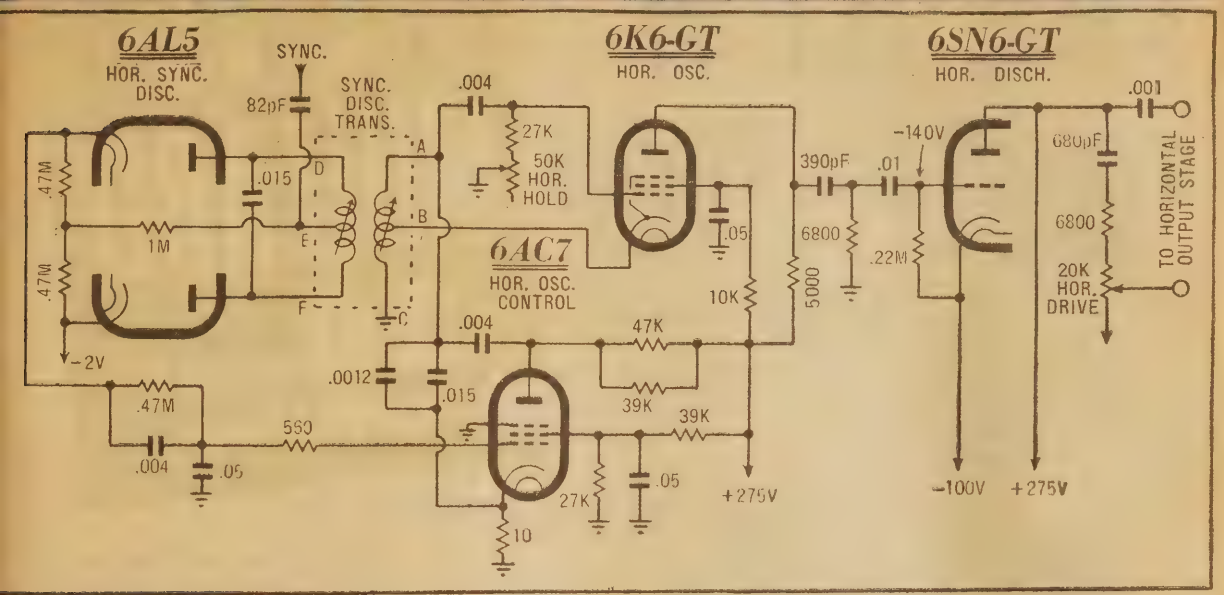

Figure 181: Basis of this line oscillator circuit is a "Hartley" type sine-wave oscillator (6K6-GT) driving a discharge tube (½ 6SN7-GT). A reactance tube (6AC7) varies the oscillator frequency in accordance with DC correction voltages from the synch. discriminator (6AL5).

This cathode (the upper one in the circuit drawing) is connected ultimately to the grid of the 6AC7 so that, under idealised conditions, the 6AC7 control valve operates with a negative bias of 2 volts on its grid.

If the oscillator should now tend to lower its frequency for any reason, the position of the synch. pulse will be displaced on the reference sine waves as shown in figure 182(b). A higher peak input voltage is thus applied to the upper diode plate, while that to the low plate is reduced.

As a result, more current will flow through the upper cathode resistor, tending to carry the upper cathode positive and, with it, the 6AC7 grid. Transconductance of the 6AC7 is increased, a more pronounced current lag becomes apparent in the plate circuit and the oscillator "sees" an apparent inductor in parallel with the coil A-B-C.

ERROR CORRECTED

The oscillator frequency rises and the synch. pulse therefore retreats toward its normal position at the centre of the slope.

In point of fact, the circuit will assume a new stabilised operating condition with the synch. pulse still displaced in the direction of the original error but by an amount which just generates enough control voltage to offset whatever factor caused the original shift. This may have been a drift in some component or maladjustment of a line control circuit.

Conversely, as indicated in figure 182(c), an increase in oscillator frequency, causing the synch. pulse to be delayed in respect to the sine wave, will increase the current through the lower diode and ultimately apply extra negative bias to the 6AC7 grid. As a result, it will lower the oscillator frequency and maintain it at the correct repetition rate as the discriminator continues to supply a permanent small correction voltage.

It is noteworthy that the controlling bias is applied to the 6AC7 grid through a 0.47M resistor, bypassed to ground by a .05mfd. capacitor. This combination prevents any abrupt change of oscillator frequency and therefore renders the system immune to substantially stray noise pulses or the loss of an occasional synch. pulse.

FREQUENCY ADJUSTMENT

Two separate provisions are made to adjust the frequency of the 6K6-GT oscillator, so that it will come within the normal control range of the reactance tube circuit.

The major or coarse adjustment is a variable core in the actual grid-cathode tuning coil A-B-C. This is made accessible above or behind the chassis and is adjusted until the picture locks horizontally.

The Horizontal Hold knob, immediately available to the user of the chassis, is a 50K. potentiometer which effectively varies the oscillator grid resistor. While not an actual "tuning" control, this effects sufficient change in the natural oscillator frequency for it to be used as a vernier, with enough range to offset any likely drift in the oscillator components or change in station pulse frequency.

It thus supplements manually the automatic frequency control action of the 6AC7 reactance tube.

With both adjustments set to give the correct nominal oscillator frequency, the receiver can be switched from channel to channel without apparently losing synch.

There is one aspect of automatic frequency controlled line oscillators which needs special mention, namely the phase or time relationship between the forward and flyback traces in the receiver and those originating from the transmitter

NO PROBLEM

The problem does not arise with directly triggered oscillators, since the synch pulse from the transmitter, coinciding with the end of the scanning frame, also triggers the retrace in the receiver. It is inevitable, therefore, that the retrace and forward scan periods in the receiver will substantially coincide with the transmitter and that the picture information will be distributed correctly across the screen area.

With an automatic frequency controlled system, this very important relationship will not necessarily hold. While the receiver oscillator will operate at the correct line frequency, it is not triggered by individual pulses but rather controlled by

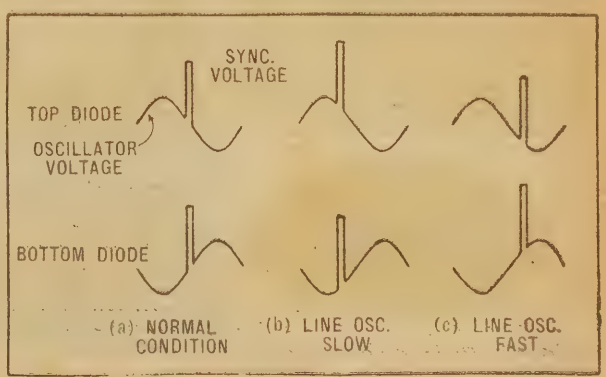

Figure 182: Under idealised conditions (a), the synch. pulse is superimposed symmetrically on the two out-of-phase sine waves. With the oscillator tending to run fast or slow, the pulse height differs, an unbalance occurs between the discriminator diode currents and a voltage appears across the common load.

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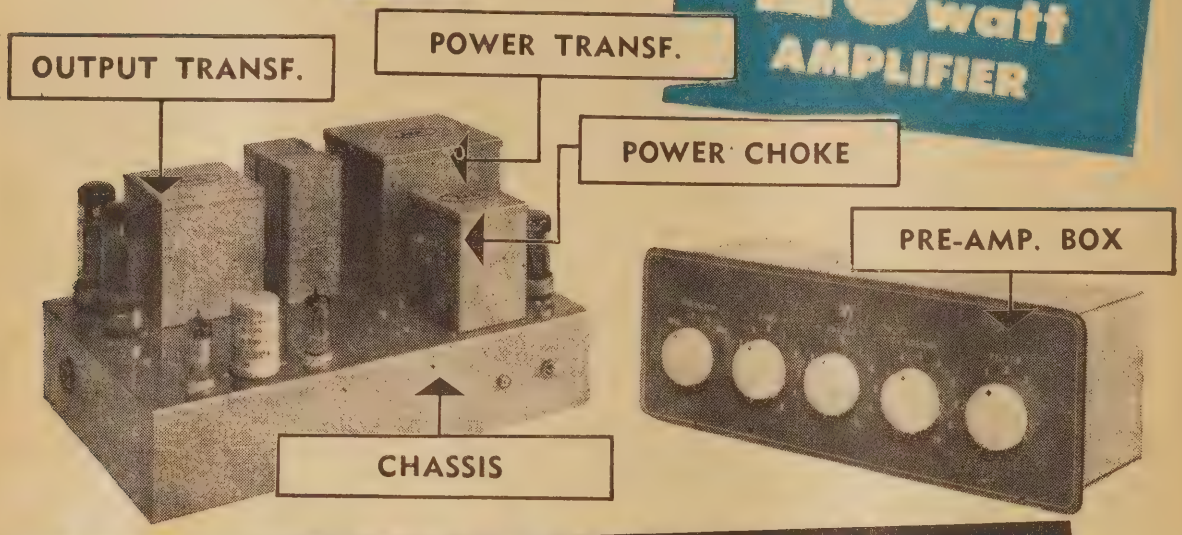

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Comprising: Main Chassis—Bottom Plate—1 Set Designation Stickers—1 Packaged Set Plated Nuts, Screws, Washers, Grommets, etc.—Chassis and Base Plate are cadmium plated and passivated. Finished in Silver Grey Hammertone Enamel

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Comprising: Perspex Escutcheon; Front Panel Assembly; Cover; Base Plate; Valve Brackets (2) — Resistor Panels (3) — 1 Set Designation Stickers — 1 Packaged Set Placed Nuts, Screws, Washers, etc. Finished in Silver Grey Hammertone Enamel.

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a DC potential produced in a discriminator or comparator circuit.

This being so, the receiver oscillator, while locked in terms of frequency, may not go through its forward and retrace cycles at the same instant as the scanning circuits at the transmitting end. The receiver oscillator may therefore trigger and produce the retrace scan at the instant when the transmitting equipment is only partway along a line.

When this happens, the picture is divided more or less as shown in figure 183, with the left and right hand portions of the picture transposed and the retrace blanking line down the centre of the screen.

DEPENDS ON CIRCUIT

In the synchroguide circuit (Figure 175, October issue) the phase of the receiver oscillator is dependent on circuit components and configuration and special precautions are unnecessary apart from adhering to previously selected circuit values.

However, the picture information can be shifted relative to the raster by modifying the coupling network between the sawtooth output components and the grid of the control valve. In particular, the 15pF. capacitor shunting the .15meg. feedback resistor has a vital bearing on phase and is chosen to give optimum phase relationship and optimum picture positioning on the screen.

Without this component in the particular circuit, or with some other circumstance upsetting oscillator phase, the picture can become displaced bodily to one side, possibly enough for the retrace blanking bar to be seen. This can become a "fault" condition, which is not always recognised.

Minor displacement can usually be offset by suitable adjustment of the centering magnets but extreme setting of the magnets, made necessary by poor picture phasing, can lead to further trouble in that corners of the picture may be clipped by the "neck shadow" effect.

In the case of the reactance controlled oscillator shown in figure 181, a special adjustment is provided for picture phasing. This is the core in winding D-E-F on the synch. discriminator transformer. Having set the core in coil A-B-C for frequency lock, the core in D-E-F is adjusted to place the blanking bar beyond the mask and thus centralise the picture.

"FOLD-OVER" EFFECTS

Over and above a simple displacement of the picture, incorrect oscillator phasing can produce visible "fold-over" effects, whereby portion of the picture appears to be folded over upon itself. This is most likely to be seen in receivers which do not incorporate automatic retrace blanking, to supplement the blanking pulse from the transmitter.

The normal condition is for the retrace period in the receiver to occur during the transmitted line blanking pulse, and to be shorter — or certainly no longer than the duration of this pulse.

This being so, the blanking pulse from the transmitter blanks out the beam so that retrace lines are not visible on the screen. By the time the blanking period terminates and the picture information recommences, the receiver forward scan is already in progress, so that the picture is displayed normally.

If the receiver retrace period begins too soon, while line information is being transmitted and before the blanking pulse arrives, there is a chance that the picture will appear to be folded upon itself, down the left hand side.

Conversely, if the receiver retrace is unduly delayed, so that it is still in progress when each new set of line information arrives, the left hand side of the picture will appear to be folded.

A still further condition is when the retrace time is too long. Folding may then be evident on both sides of the picture, phase adjustment serving only to decrease one foldover by increasing the other.

IN SYNCH. BUT OUT-OF-PHASE

Figure 183: This picture illustrates what happens when the horizontal oscillator is locked but in the wrong phase relationship. The receiver flyback occurs during the transmission of line information, while the transmitted blanking pulses appear down the centre of the screen as a black bar.

Remarks about synch. phasing do not hold in respect to the frame oscillator, because nearly all receivers use direct triggering for the frame circuit and correct phasing is more or less automatic. However, improper operating conditions can occur due to circuit faults which prolong the frame flyback period or grotesquely distort the scanning current through the yoke windings.

In such a case foldover can become evident along the top of the picture or extreme compression of one or more regions.

To be continued.

A TWIN 10w. STEREO AMPLIFIER

(Continued from Page 37)

been corrected by altering values of the compensating components.

With this amount of feedback, a slight burst of oscillation was noticed at full output on very low frequencies, indicating that such alteration would be necessary to restore the original degree of stability. But it does indicate a safety margin of at least 10 db.

No low frequency oscillation was experienced at any time through the tests.

A further oscillogram shows a sine wave at 50 cycles with 32 db of feedback and a measured output of a little over 10 watts.

The power output curve is extremely good. At 1 Kc the output for a clean sine wave is 11.3 watts per channel, and this continues without serious malformation up to 50 Kc. At 50 cycles output was 10 watts and at 30 cycles about 8 watts. This is a very good performance.

The input sensitivity for full output is 180 millivolts.

Our tests have been carried out in conjunction with the stereo control unit recently described, and it can be considered the standard type for use with crystal pick-ups which are likely to be the most popular and least expensive for some time to come.

With this unit, and checked with a stereo test record, essentially flat response is obtained between 40 cycles and 10 Kc, with some small variations up or down associated with crystal pick-ups. The unit itself is a few db down at 20 Kc, but for all practical purposes this is not significant.

If the control unit is used, its output plug can be wired to conform with that of the amplifier. The unit was designed originally for use with two separate amplifiers, and that is why two output connectors were included in it.

Another ROLA First!

This new Rola Model 2C loudspeaker has been designed for use in personal portables, particularly the sub-miniature transistorized types Its physical dimensions are such that it will "marry" with standard printed circuit wafers and its efficiency such as to provide maximum performance from the tiny receivers for which it is designed.

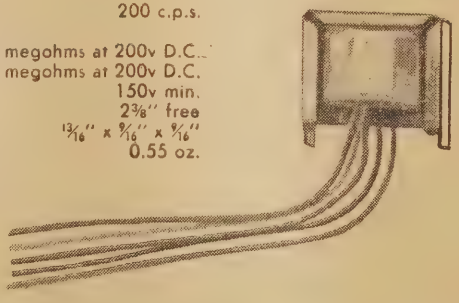
ROLA MINIATURE TRANSISTOR LOUDSPEAKER SPECIFICATIONS

Power handling capacity:	250 mWatts peak
Diaphragm:	
Fundamental resonance	
F1 cone	325 c.p.s. ± 25 c.p.s.
Frequency response:	300 c.p.s. — 4.5 K.C.
Voice coil impedance:	15 ohms at 1,000 c.p.s.
Air Gap Flux Density	7,000 Gausses
Gap flux:	11,100 Lines

Principal dimensions:	
Overall diameter	2¾"
Diameter of baffle opening	2½"
Diameter of voice coil	9/16"
Depth from pad ring to rear	1 1/32"
Finish:	
Cadmium plated housing and magnet assembly	
Weight:	2¼ oz. without transformer.

ROLA MINIATURE TRANSISTOR TRANSFORMER SPECIFICATIONS

Power handling capacity:	250 mW
Core saturation at 1000 c.p.s.:	Bmax > 5,000 Gausses
Centre tap unbalance:	
Output transformers	± 1.7% turns
Driver transformers	± 0
Insertion loss:	— 2 dB.
Low frequency cut-off:	200 c.p.s.
Insulation resistance:	
Between windings	> 100 megohms at 200v D.C.
Windings and core	> 500 megohms at 200v D.C.
Breakdown voltage:	150v min.
Lead length:	2⅜" free
Overall dimensions:	13/16" x 9/16" x 9/16"
Weight:	0.55 oz.



Colour code

Output transformers —	Primary start	Brown
	C.T	Red
	finish	Blue
	Secondary start	Black
	finish	Green
Driver transformers —	Primary start	Red
	finish	Blue
	Secondary start	Yellow
	C.T.	Black
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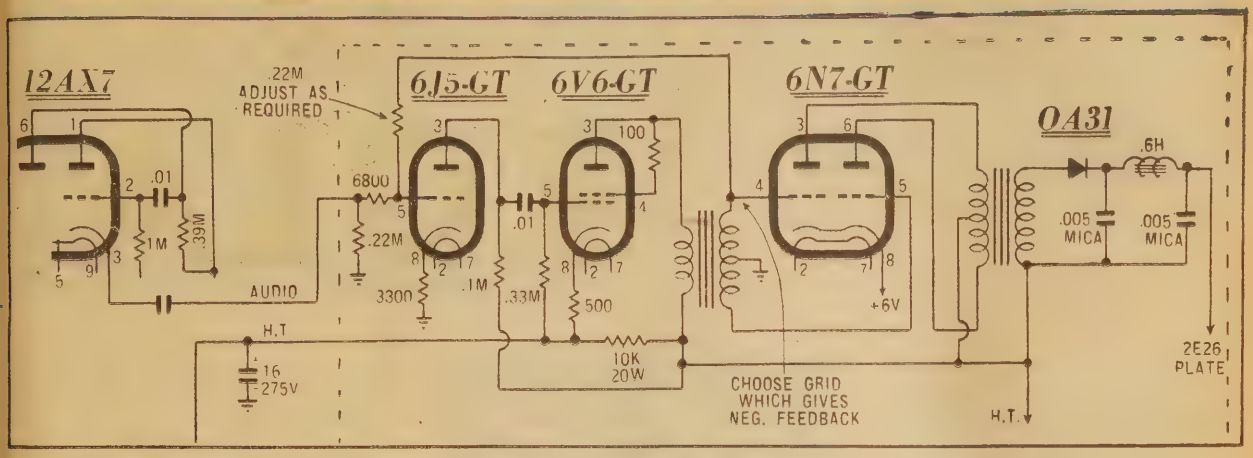


Details of modification to mobile transmitter described in the October, 1958 issue. A 6J5-GT provides additional audio gain while a negative peak clipper and filter follow the 6N7-GT class B modulator.

High average modulation without splatter and without excessive distortion is the object of every amateur or commercial communication transmitter designer. Information on methods of increasing the effectiveness of amplitude modulated transmitters is given in this article which reviews several highly practical methods.

AN oscillographic analysis of speech waveforms can readily be used to demonstrate that they are in general very peaky in nature and that the average amplitude varies over wide limits even when the speaker consciously tries to keep his voice at a constant level.

A wide dynamic range and frequency response are not necessary for effective communication. In fact a limited frequency response plus limitation of the change in average level are highly desirable in order to make best use of the modulation capability of the transmitter.

The subject was discussed in some detail in the December 1957 issue. For more detailed information, we refer you to the article on page 48 of that issue entitled "A Clipper-Filter For Amplifiers."

The device described consists of a microphone preamplifier with delayed AGC, designed to hold the average level fairly constant with wide variations in the speaking distance and level. This is followed by a symmetrical shunt diode clipper with constants arranged to reduce the peak amplitude of speech by a factor of about 2 to 1.

HOW MUCH CLIPPING?

It has been found that 2 to 1 (6 db) gives a worthwhile increase in level with little apparent change in quality.

Distortion following clipping is removed by a two-section filter having a sharp cut-off above 3 Kc. The low frequency response of the system is reduced by using a small value coupling capacitor after the preamplifier stage. Low frequency speech components are less effective for communication purposes and, so that they will not affect the average depth of modulation, are removed before even reaching the AGC rectifier.

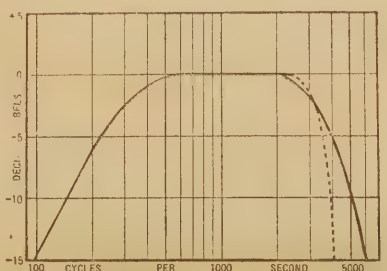
It is important that low frequency attenuation be confined to one stage, otherwise an undesirably high rate of roll-off at low frequencies will be present. Our general recommendation is that the response be about 6 db down at 200 cps and 12 db down at 100 cps.

SMALL UNIT

One of the main features of the unit described in the December 1957 issue is that it involves no large high-power components. In general, it may be constructed on a small chassis or plate and room for it found on an existing modulator chassis. At the worst, a small desk unit, feeding into the main modulator, could be constructed.

It is certainly effective and should allow the average modulation percentage with speech to remain around the 90 per cent mark.

The scheme has some disadvantages, one of which is the possibility of variations in gain between the clipper and the modulator. It is therefore necessary to check occasionally that the depth of modulation is optimum. Due to regulation of power supplies, the clipper reference voltage may not keep in step with the voltage applied to the class C stage.



Frequency response curve for the overall modulator. High frequency attenuation is due to filter. Low frequency attenuation is discussed in the text. Broken curve shows response of low pass filter described in the Dec., 1957 issue.

A good arrangement would be a class-B modulator with a reserve of power output, and a separate power supply, while the class-C power supply and the reference voltage for the clipper should be obtained from the same source. Some negative feedback over the modulator would also be helpful in keeping the gain constant.

Yet another method, and one which has much to recommend it, is to adjust the load on a pair of class-B modulators so that the stage clips just before 100 per cent modulation is reached. This is done by increasing the load applied to the valves and in general can only be done experimentally because allowance must be made for transformer losses. In this case it is desirable that both the class-C and the class-B modulator stages operate from the same power supply. The onset of clipping is then set mainly by the ratio of the transformer.

FILTER NECESSARY

Sharp cornered waveforms due to clipping cause spreading of the signal and have to be removed by the addition of a low pass filter between the modulation transformer and the class-C amplifier. The principle is the same as that discussed earlier.

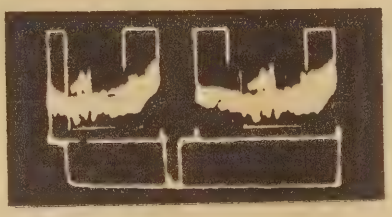
It is not always practical to use a tapped modulation transformer and an alternative means of achieving a similar result may be worth seeking. Such was the case with the mobile transmitter which was described in the October 1958 issue.

Splatter occurs when the carrier wave is interrupted abruptly on the negative half cycle of modulation. It can be avoided by means of a series rectifier, which presents a high resistance when the modulator attempts to take the class

(Continued on Page 108)

TV Test Signals May Aid Servicing

Fig. 1. An ABC studio monitor (right) shows the normally concealed reference-white signal at the top. The waveform below shows two lines of horizontal scan that contain this reference signal. Also see Fig 4.



By JOSEPH A. RISSE

International Correspondence School

Since the inception of television in Australia, there has been a good deal of discussion about the maintenance of black and white levels during transmission and its implications in regard to receiver design. This article from "Radio & TV News" outlines some of the methods which are being used or considered in the U.S. to facilitate preservation of correct video levels.

SINCE the early days of television broadcast engineers have wanted a method of telling immediately whether their studio and transmitter gear was operating properly, without taking the program off for testing or having to wait until the degradation became serious enough to be noticed.

BETTER STANDARDS

The telephone companies, since they relay the video signal cross-country, also would like some simple method of evaluating operation while the program is on. Added to this is the wish of the FCC for a better and immediate means of determining whether a particular station is maintaing operation in accordance with good enginering practices—for example, whether sync percentage, modulation depth and frequency response are within specifications.

Last but not least, an automatic indicator built into the signal would be a great boon to the service technician in troubleshooting and adjustment.

It now appears likely that a standard transmission test signal of some sort will be adopted in the foreseeable future. This article will describe these test signals in general. Then the ones being experimentally used at the present time will be discussed in detail, since it is these you will most likely have an opportunity to observe now.

One of the most difficult things to accomplish in the whole TV transmission process is the maintaining of consistent video levels and modulation depth. As far back as 1950, stations and networks were experimenting with amplitude-reference test signals.

TEST SIGNALS

These were generally inserted during the vertical interval, specifically at the end of vertical blanking out before the first active line in the picture. L. Stantz, at WNBF-TV (Binghamton, N.Y.) in 1950 was using a test signal, called then the "white pilot" signal. Fig. 2A shows a sketch of the vertical interval as it is normally; Fig. 2B, after two full horizontal lines of this reference-white test signal are added. Fig. 6 illustrates how these signals would show up on the oscilloscope.

This signal served quite well in helping to keep video levels consistent between studio and transmitter.

PURPOSE OF SIGNAL

You might ask, "Just what does this reference-white signal do?" As you know, the amount and intensity of white and black in representative TV program scenes is continuously changing. At the beginning of each new program, it is hard for the transmitter engineer to judge whether his video level is set to the proper amplitude.

He may not be aware, for example, that an opening scene is a little darker than average and he might adjust his video gain too high.

Then when the program shifts later to a normally bright scene, amplifiers may overload or the excessive whites may drive the transmitter to zero carrier, causing clipped whites and audio buzz.

With a reference-white signal as a permanent part of the video signal, transmitter personnel need only adjust levels using this reference-white signal as a standard.

The engineer controlling the signal at the camera will also be using this as a standard and will not permit his video level to exceed the reference-white signal. In other words a, reference-white test signal establishes a standard peak video level for the convenience of technicians at the studio or transmitter or, in the case of network programs, at the relay points along the way.

OTHER COMBINATIONS

The signal can be set to the proper level at the program's beginning, irrespective of light level of the scene, with no further adjustment required.

Many other test signals and combinations are possible. The most useful for monochrome testing are of the same general type as just described.

These can be used as standards for observing transmission-system amplitude linearity characteristics. Important, too, are test signals that can be used for evaluating frequency and phase response.

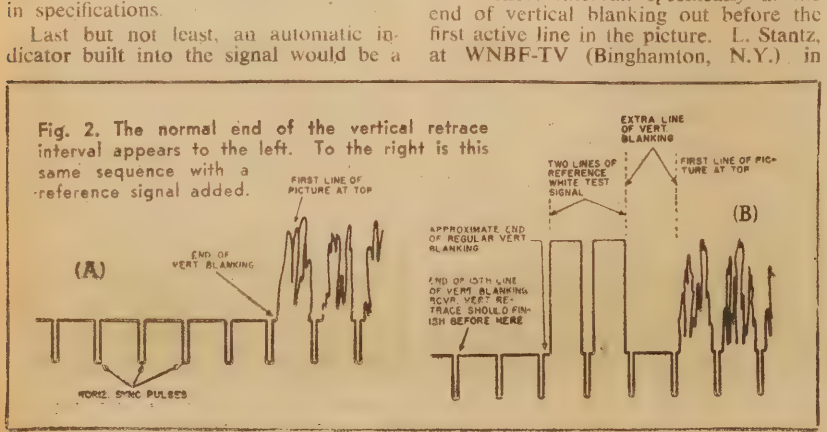

(A)
FIRST LINE OF PICTURE AT TOP
END OF VERT. BLANKING
HORIZ. SYNC PULSES
(B)
EXTRA LINE OF VERT. BLANKING
TWO LINES OF REFERENCE WHITE TEST SIGNAL
FIRST LINE OF PICTURE AT TOP
APPROXIMATE END OF REGULAR VERT. BLANKING
END OF 10TH LINE OF VERT. BLANKING INTV. VERT. RETRACE SHOULD FINISH BEFORE HERE

Fig. 2. The normal end of the vertical retrace interval appears to the left. To the right is this same sequence with a reference signal added.

American Broadcasting Company is at present experimenting with a test signal, one line of which is shown in Fig. 4. This reference-white signal, instead of occupying two full horizontal lines in each field, appears only for a few microseconds at the beginning and a few microseconds at the end of each of the two lines.

This arrangement permits "hiding" the reference-white behind the receiver mask curvature, in the left and right corners at the top of the raster. Hiding is desirable to avoid the possibility of disturbing the viewer with activity in the picture that is not part of the program.

ILLUSTRATION

Fig. 1 shows a photograph, taken directly from a studio picture monitor, of a typical A.B.C. program scene as it appeared on the studio monitor. The scope waveform is displayed at one-half line rates (7875 cps) directly below. At the left and right top of the picture can be seen the reference-white signals.

These are visible here because of the normal practice of underscanning the monitor picture tube, therefore permitting the complete picture to be seen at all times by control room technicians. (This is the reverse of the practice of over-scanning, or pushing the top and bottom of the picture slightly beyond the limits of the tube face, as is normally the case with home receivers.

In this way, the reference signals will not be seen by the ordinary viewer.) In the waveform beneath, the reference-white signals appear as square waves or pulses. The flat tops of these pulses represent the level which is not to be exceeded in amplitude by the video signal. (If the test signal of Fig. 2B were used, the white bars would appear as one continuous white line across the top of the picture in Fig. 1.)

AIR TESTS

Having experimented with reference and test signals since early TV days **Columbia Broadcasting System** in August, 1957, began using an on-air test signal during live programs from New York. Fig. 5 illustrates the details and Fig. 3A shows the scope waveform at the vertical rate. Fig. 3B shows this waveform expanded in the vicinity of the vertical interval.

The reference-white signal might be just barely discernible in this photograph, but a reference-black pulse is quite apparent. A reference-black pulse is used primarily to adjust clipping circuits in station transmitting equipment; for proper operation there should be no picture blacks extending below reference-black which, in turn, should be at a point above the blanking level equal to about 1/10 the blanking-to-full-white amplitude.

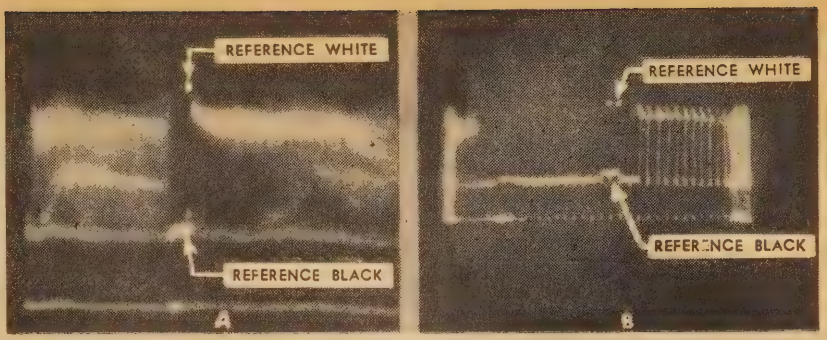


Fig. 3. CBS test signal including reference-white and reference-black levels. The scope waveform is at the vertical rate in (A), expanded vertical in (B).

Let's state this another way. If we designate the vertical distance on the oscilloscope waveform between blanking and the reference-white level as 100, the blanking will be at zero level. the reference-black will be at 10 per cent and reference-white will be at 100 per cent. The video information is, at all times, kept within the 10 to 100 per cent region of the waveform.

CBS PROGRAM

Fig. 7, a photo of an actual C.B.S. program scene, shows just where (upper right-hand corner) the reference-white test signal appears in the raster. Notice that the test signal occupies only a very short portion of each line in which it appears.

This permits the use of other optional signals, as may eventually be deemed necessary (as for colour) in the areas marked A in Fig. 5. The vertical-interval portion of the picture, greatly expanded vertically, is shown in Fig. 8. Here, reference-black is not too noticeable since there is only a 10 per cent difference in contrast between it and blanking. Clearly shown are the four lines (two in each field) of vertical blanking between test signals and beginning of active picture.

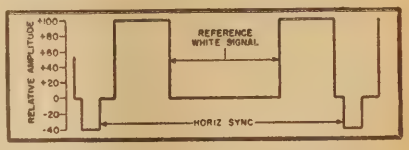


Fig. 4. Diagram of the ABC reference signal. Also compare this with Fig. 1.

National Broadcasting Company is using six lines (three per field) of the test signal shown in Fig. 9. N.B.C. also alternates this one with at least two other types of test signals, not too much different from the one in Fig. 9. In each case, the test signals appear after the normal, minimum, vertical-blanking period.

STEP SIGNAL

One inactive line appears between the test signal and the first line at the top of the picture. The test signal of Fig. 9 consists essentially of three stair-steps, the steps being equivalent to one half of peak amplitude, black and white, respectively.

Following the horizontal-sync pulse is the colour flag burst. The half-ampli-

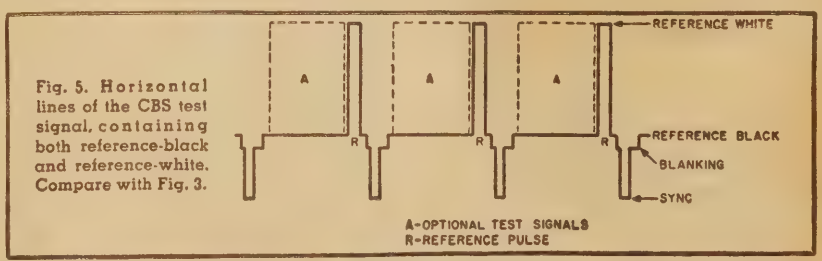


Fig. 5. Horizontal lines of the CBS test signal, containing both reference-black and reference-white. Compare with Fig. 3.

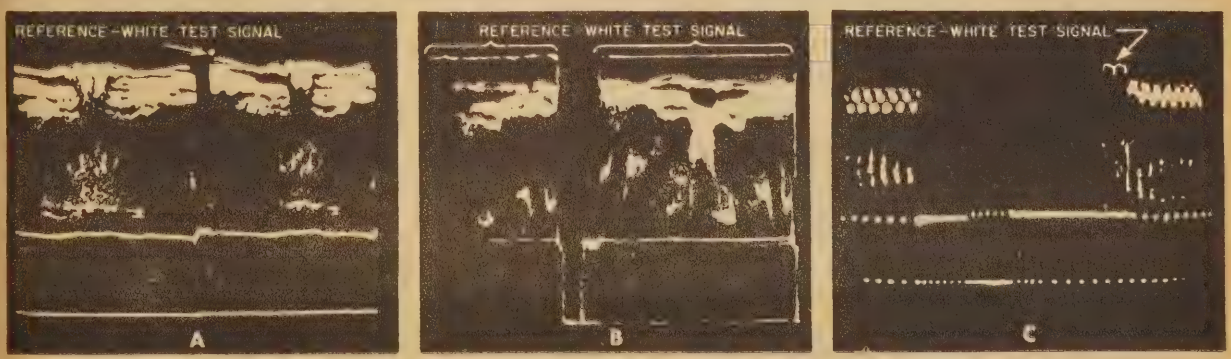


Fig. 6. Scope waveforms of the test signal in Fig. 2 show reference-white (A) at the vertical rate, (B) at the horizontal rate, and (C) at a portion of the vertical trace of (A) that has been expanded horizontally to bring out detail.

tude bar is the same type of pulse as reference-white, but is placed at half the blanking-to-white amplitude. Because a half-amplitude bar is approximately the same as the a.c. axis of the video signal, it will suffer less than any other type from amplifier and transmitter non-linearity.

This makes it easy to determine whether there is any compressing or stretching of whites or blacks. The half-amplitude bar must, at all times, therefore, be halfway between white and blanking.

In the middle of the half-amplitude step of the signal of Fig. 9, there is superimposed 10 microseconds of 3.579-mc. signal phased 180 degrees from the flag burst. In the middle of the next step, representing black, is superimposed 10 microseconds of 3.579-mc., phased to magenta.

MANY USES

The step representing white has superimposed in the middle of it, 10 microseconds of 3.579-mc. signal phased to cyan. As far as the step corresponding to white is concerned, its 3.579-mc. sine waves are shifted downward so that the peaks correspond to white; thus no part of the overall test signal exceeds peak white.

It can be seen that this signal serves the multiple purpose of evaluating white, black and mid-amplitude linearity, as well as differential gain, differential phase, and low-to-middle frequency response (by using corners and leading and trailing edges of stair steps).

The frequency-burst test signal shown in Fig. 10 includes a reference-white signal and several bursts of test frequencies, all transmitted at identical amplitudes.

WIDELY USED NOW

This signal is now widely used for in-plant testing, but it obviously would be useful if adopted as part of a standard test signal. The frequency bursts, of course, are for evaluating the frequency response of the whole TV transmitting system.

The frequencies of this test signal are, in the order shown after reference-white, .5, 1.5, 2.0, 2.4, 3.6 and 4.2 megacycles. Other frequencies can be inserted if desired. This signal could be particularly useful for receiver alignment work.

Under favourable conditions, it could alleviate the need for connecting a sweep or single-frequency generator.

The signals which have been proposed for evaluating transmission performance might be useful also to the TV service technician. He could tell, for example, by use of a high-quality scope, whether or not he has poor amplifier linearity in the r.f., i.f., or video circuits. Also by observing the sync or white clipping, the effects of different settings of a.g.c. may

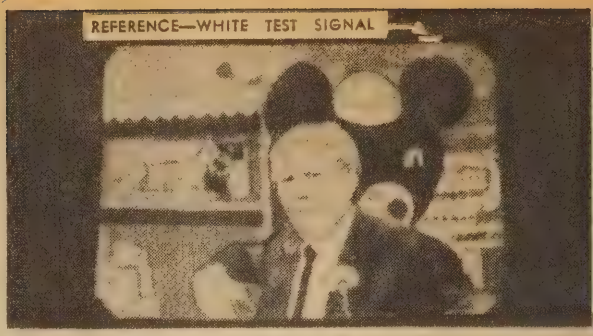


Fig. 7. Photo of an actual CBS program, showing the position in the raster of the reference-white signal, upper right

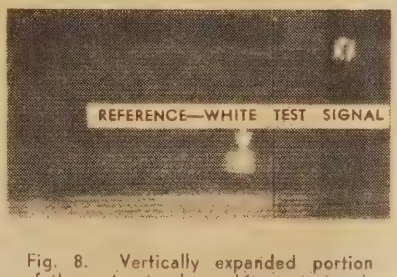


Fig. 8. Vertically expanded portion of the raster to show white test signal.

be observed. Loss or compression of sync could be established or located.

Various other applications of these test signals will doubtless develop once a standard signal is adopted.

There is not much likelihood that these test signals will have any undesirable effect on normal TV receiver operation. They occur close to vertical sync, but well after the sync pulse has ended, so there should be no erratic vertical triggering.

The test signals might show up during vertical retrace, but even without test signals, slow receiver vertical retrace results in fold-over or in the appearance of video information before the finish of vertical blanking. Normal vertical blanking specifications call for at least 9 full lines of blanking per field, after the end of vertical sync.

BLANKING PERIOD

Most stations transmit closer to 12 lines after the end of sync. The maximum number according to E.I.A. specifications is 16 (including three lines of trailing equalising pulses). Between the minimum of 9 and the maximum of 16, there are 7 lines that can be used for test signals without danger of hurting receiver performance. However, none of the plans call for using more than the final three of four vertical blanking lines.

Since most stations do not now use the maximum vertical-blanking period, it will be merely a matter of adding the test signals to the number of blanking lines now existing in each case. The test signals might cause intercarrier buzz—if whites in the normal program cause buzz in a particular receiver—because parts of the test signals are white. However, the test signal will be present in every vertical field and any buzz will therefore be continuous, making the receiver trouble easier to eliminate.

EFFECT ON RECEIVER

At the moment, we might conclude that receiver performance will not suffer. Rather, the end result should be beneficial. It might be worth your while, if you are able to observe a video signal containing the test signals on a scope, to become familiar with the appearance with the scope sweep set to both line and field rates. A scope good enough to pass all the video frequencies should be used for best results.

Elaborate scopes have a line-selecting feature, but any standard wide-band service scope will show the test signals effectively. Details of the vertical interval can be seen by turning up horizontal gain.

A variety of other test signals is possible. However, until there is formal adoption of these signals in one form or another, discussion beyond what has been covered here would best wait for some future date.

625 FOR BRITAIN?

According to reports by an Australian TV executive, recently returned from overseas, Britain is becoming less and less content with her (now) outmoded 405-line system. Whereas British TV interests have, in the past, done their best to justify the system, it seems that many now are having second thoughts on the idea.

At least one influential newspaper is backing the move for conversion to 625 lines, presumably before the country is committed to a colour system of any kind, while a recent report of the establishment of an experimental 625-line transmitter would seem to be significant.

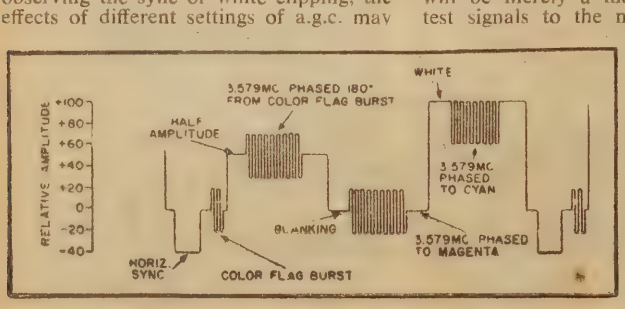


Fig. 9. Proposed NBC test signal, now in use, can be used for checking colour as well as black-and-white receivers

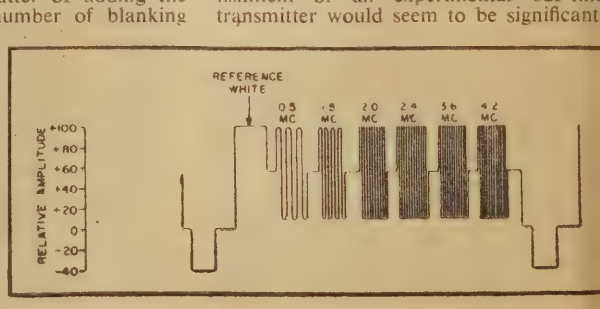


Fig. 10. This train of test bursts at different frequencies would enable a check of TV receiver response and bandwidth.

NEW BOOKS

AN INTRODUCTION TO TRANSISTOR CIRCUITS. Published in 1957 by Oliver and Boyd, Edinburgh. Stiff cover, 154 pages. Illustrated by circuits and line drawings.

E. H. Cooke-Yarborough, the author, is head of the Electronics Division, Atomic Energy Research Establishment, Harwell, and the book is published under the sponsorship of the United Kingdom Atomic Energy Authority. It is based on a series of lectures given at University College, London, in 1955.

The word "Introduction" in the title would apply only to people with some fundamental training in Mathematics and Electrical Engineering. Such people will find it a clear discussion beginning with fundamental transistor action and developing the subject to take in transistor amplifiers, pulse circuits, the application of transistors to computors, etc. Naturally, the last are given some emphasis since the experience of the author and his colleagues has been concentrated along these lines.

Not the least valuable feature of the book is the long list of references to other publications on the subject which appear at the end of each chapter.

The review copy from Technical Book and Magazine Co., 295 Swanston Street, Melbourne. The Australian price is 26/ plus 1/6 postage. (M.V.F.).

FOUNDATIONS OF WIRELESS by M. G. Scroggie, B.Sc., M.I.E.E., a "Wireless World" book published by Iliffe and Sons Ltd. Stiff cover, 388 pages, illustrated by 278 line drawings, graphs and circuits.

Our review of the sixth edition appeared in the August, 1958, issue when we concluded by stating that it was a book which we would be glad to recommend to any beginner. The same comment applies to the new seventh edition.

Further changes have taken place in both the text and the diagrams in order to keep pace with modern developments. Some of the earlier text has been dropped but additions bring the total to an extra 39 pages and more than that number of diagrams. One chapter is devoted to an elementary treatment of transistors while one of the later chapters deals with transistor equivalent circuits, biassing and stabilising circuits together with methods of calculating voltage and current gains.

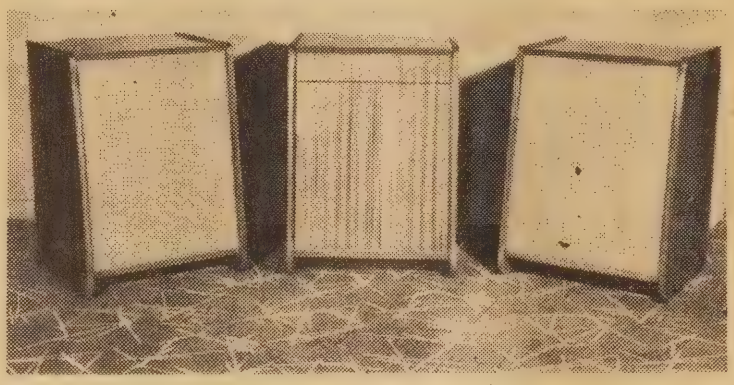
All the fundamentals are there. Discussions of resistance, capacitance, inductance, networks, valves, alernating currents tuned circuits, aerials and even the basic concepts of television and radar.

Mr Scroggie is a man with an enviable ability to bring the abstractions of radio theory within the realm of everybody who wants to learn.

Our copy from the Technical Book and Magazine Co., 295 Swanston Street, Melbourne. The price is 25/ plus 1/6 postage.

JUST ARRIVED!
STEREOGRAM CABINETS

Further supplies have now arrived of the "G" series cabinets designed to combine low cost with flexibility and style.



Illustrated above, these cabinets are immaculately finished in maple, walnut or rosewood polished timber, matching in size, style and colour.

Dimensions: Height 29in, width 21¼in, depth at the base 18¼in. Speaker cabinets are covered at front with plastic grille cloth, fully felt lined with provision for acoustic resistance unit and optional tweeter.

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Here's your answer, Tom!

Variety that would tax the ingenuity of a professional quizmaster is characteristic of Tom's queries and this month's mailbag is no exception. The few we have selected should prove of interest to most, as they are of a general nature and deal with subjects encountered by the average experimenter.

Could you explain the operation of a valve and its associated components when oscillating?

An oscillator makes use of positive feedback to generate oscillations. There are numerous circuit arrangements but the essential principle is to provide a positive feedback path between the output plate circuit, and the input grid circuit. This feedback may be controlled and the whole circuit made to oscillate at a predetermined frequency

Probably the most common example of an oscillator is that found in a superheterodyne receiver. The oscillator circuit is generally based on the triode section of a multi-element converter valve and, for the sake of clarity, a triode is shown in the accompanying circuit.

The frequency at which the oscillator will operate is determined chiefly by the coil and tuning capacitor in the grid circuit. A second winding, coupled closely to it and connected to the triode plate, provides the necessary feedback.

The action of the oscillator might be explained this way: As the valve warms up after switching on, any slight change in plate current is communicated by the coupling between windings to the grid coil, appearing as a signal on the grid.

Provided the coils are connected in such a way as to produce positive feedback, the signal on the grid will be of such a polarity that it tends to accelerate the original change in plate current.

This may have tended, for example, to make the plate current increase. Having reached a maximum figure, dependent on the valve and circuit constants, the plate current rise must cease, the field around the coil must collapse and this will reverse the signal on the grid.

The plate current, therefore, tends to fall, and, because of the feedback effect, the grid accelerates this fall.

So the action continues spontaneously, the plate current and grid voltage oscillating between limit conditions at a frequency determined by the grid coil and tuning capacitor.

★ ★ ★

What is a VU Meter as used in tape recorders and in what way is it superior to a vacuum Tube Volt Meter? What does VU stand for?

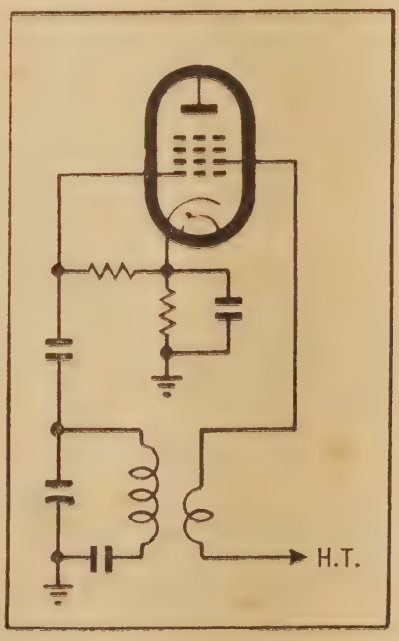
Taking the latter part of your query, Tom, the letters VU stand for "Volume Units," which indicate volume level. The volume level in VU is numerically equal to the number of decibels above a reference level of 1 milliwatt in 600 ohms.

The obvious use for a volume meter in a tape recorder is to indicate the recording level and to ensure that it remains within limits suitable to both the recorder and the tape. However, not all level indicators in tape recorders could be classed as VU meters, since a true VU meter is accurately calibrated and has a special movement enabling it to register sudden peaks in level, without excessive "overshoot."

VU meters are very widely used in broadcast practice and operate directly across the program line. It is not necessary to use the vacuum tube voltmeter principle for them.

The main use of a vacuum tube voltmeter is for general circuit testing. Such instruments will register audio output, but no attempt is made, either in the circuitry or the meter movement to achieve a fast but heavily damped action.

They are, therefore, less effective as program level indicators—but a lot more useful for other things!



Typical converter circuit

I have often seen the term "ringing" used in audio articles. What does it mean?

In an audio amplifier, Tom ringing is essentially a tendency toward self-oscillation. It is a tendency to produce a damped wave train after a sharp, stimulating signal has ceased.

Ringing recalls the characteristic of any resonant circuit, which tends to generate a series of gradually weakening oscillations, when excited by a momentary impulse.

Ringing in an audio amplifier is usually indicative of a peak in the extreme high frequency response, usually between 30 and 300Kc. The response peak produces a change in phase of signal through the amplifier, causing negative feedback to appear as positive feedback, thus giving rise to damped or free oscillation.

Ringing is usually observed on the screen of a CRO with the amplifier under test and fed with a square wave of frequency between about 1 and 5Kc.

The state of ringing when excited by an impulse need not be electrical in nature. Electro-mechanical devices such as loudspeakers and pickups are also prone to this form of distortion, for mechanical resonant circuits, when shock excited by sharp signal pulses, may continue to vibrate after the pulse has ceased.

★ ★ ★

How are kilocycles converted into meters?

It is very simple Tom, when you know how. All you need is a paper, pencil and the ability to do long division.

You write down the number of kilocycles concerned and the figure 300,000 and proceed to divide the number of kilocycles into this figure. The answer will be in metres.

Alternatively, if you know the number of metres, you can work out the frequency in kilocycles by dividing the metres into 300,000. The answer obtained may have a remainder in which case it can be worked out further and expressed as a decimal figure.

Should you then wish to convert the kilocycles into megacycles simply move the decimal point three places to the left. As an example 1650.5 kilocycles will become 1.6505 megacycles.

By the same token 610Kc is equal to .610Mc.

If you wish to work directly in megacycles, simply change the figure 300,000 to 300. To convert megacycles to metres then, you divide the megacycles into 300. Likewise dividing metres into 300 gives you the frequency in megacycles.

★ ★ ★

What difference results in connecting the suppressor to earth or cathode?

For most applications, the suppressor grid of a pentode valve is connected to cathode and, in many valves, the connection is a permanent one inside the envelope. Little or no difference would result in most such cases from connect-

ing the supressor to ground, though it is generally wise to follow the circuit.

Some special applications require the suppressor to be connected or used in a specific fashion as, for example, a supressor modulated stage in a transmitter. In some oscillators, also, the supressor is connected to earth in order to isolate the plate more effectively from other electrodes.

★ ★ ★

What is modulation hum? And what causes it?

Modulation hum, as the term implies, is hum that modulates a radio signal in a receiver prior to its being demodulated or detected.

The modulation process may occur in a number of ways. Capacitive coupling between the primary and secondary of the power transformer, particularly if the bulk of the incoming signal arrives via the mains, can cause a hum to be superimposed on the signal. The frequency of this hum would be 50 c/s.

An aerial running close to the mains can produce a similar effect, again through capacitive coupling.

The magnetic field from a power transformer or choke may induce a hum in aerial circuits, particularly in loop or "loopstick" aerials. Likewise, if in close proximity, the electron stream within a valve may be modulated.

Inadequate filtering on the oscillator plate supply in a superhet can also cause modulation hum, due to the 100 cps ripple present in the supply. The process is that of frequency modulation and the cure is to improve the filtering.

Amplitute modulation of the signal by the hum frequency may also occur in a valve working on a non-linear part of its characteristic. A common reason for this type of hum is insufficient filtering for the screen of an amplifier. If the AVC line carries bias generated across a back bias resistor it is also possible for modulation hum to occur in valves controlled by this AVC.

Modulation hum can normally be recognised by the fact that it is present only when a signal is tuned in, disappearing when the receiver is not set to any particular station. On the contrary, normal filter hum affecting the audio system is present at all times and is unaffected by tuning.

★ ★ ★

What is a rhombic aerial?

A rhombic aerial is a directive aerial consisting of an equilateral parallelogram of wires. It is usually horizontal and each element is some definite number of quarter wavelengths long.

The elements meeting at one end of the longer diagonal are connected together through a resistor while the elements at the opposite end are connected to the transmitter or receiver. Rhombic aerials are designed for and used on specific frequency bands, and exhibit highly directive properties. They are not used for general listening.

★ ★ ★

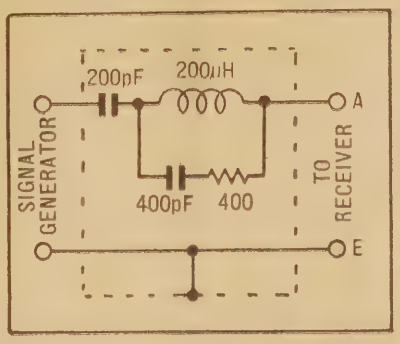
What decides the values used in a dummy aerial for the purpose of aligning receivers and, what are the values used?

When aligning a receiver with a signal generator, it is desirable for the generator to present across the aerial terminals an impedance which is similar to that of an average aerial. If this requirement is not met, the aerial coil may be peaked to a setting which seems right on the generator, but which is quite wrong for an ordinary aerial.

An aerial may be similated by making up a "dummy" aerial from selected values of inductance, capacitance and resistance. Unfortunately, it is very hard to decide what is an "average" or an "ordinary" aerial, since they are likely to vary tremendously in length, height and position.

Engineers have evolved certain standard "dummy" aerials for the broadcast band and for the short waves. They cannot be used with any old alignment oscillator, however, or at least their value is largely offset.

For a more detailed study, Tom, we would suggest you try to borrow a laboratory textbook, which will explain matters better than we can just here.



Dummy aerial load

Coaxial connectors are used for low loss connections, such as in tape recorders, etc. However, the screened jack is also used for this purpose. Would the screened jack be inferior to the coaxial connector? If not, why are coaxial connectors used?

A screened jack should be quite in order for most audio applications and cannot fairly be classed as inferior to the coaxial connector or similar modern fittings. The main difficulty with screened jacks is that they are inclined to be bulky and, with the present trend to miniaturisation, smaller fittings are generally preferred.

However, one mustn't forget, Tom, that multi-circuit jacks can often be made to perform a switching function when the plug is inserted and this fact is often used to advantage.

I have often wondered if radio waves can pass under the sea, hence my query. Can submarines communicate by radio to the surface or shore when submerged?

Normal, medium and short wavelengths are severely attenuated by the sea making radio communication with submerged submarines impossible with normal equipment. However, by employing very low frequencies, 50kc or below, it is possible to communicate with submerged submarines on a world-wide basis. The difficulty remains, however, that the submarines have to surface to reply, if any reasonable distance is to be covered.

Base stations to communicate with submarines use enormous aerial systems, strung between high towers and across mountain valleys.

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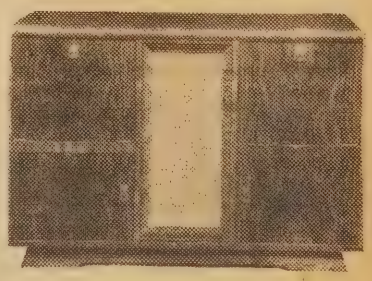

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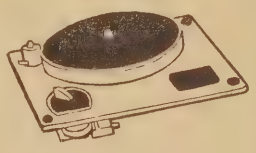
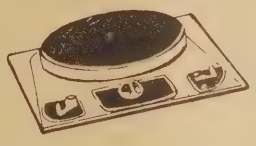


GARRARD 301 TRANSCRIPTION MOTOR



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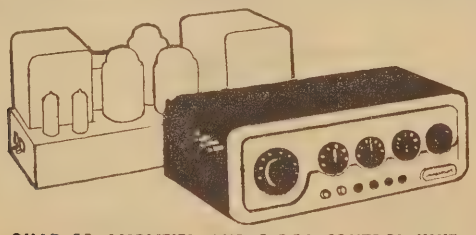

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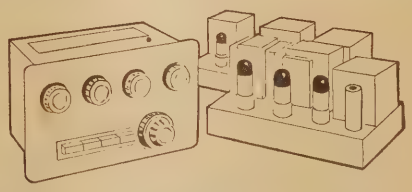

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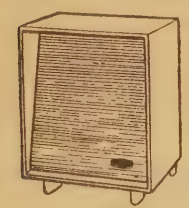

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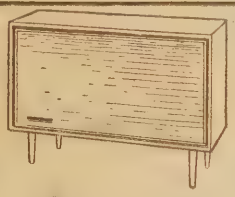

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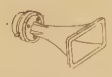

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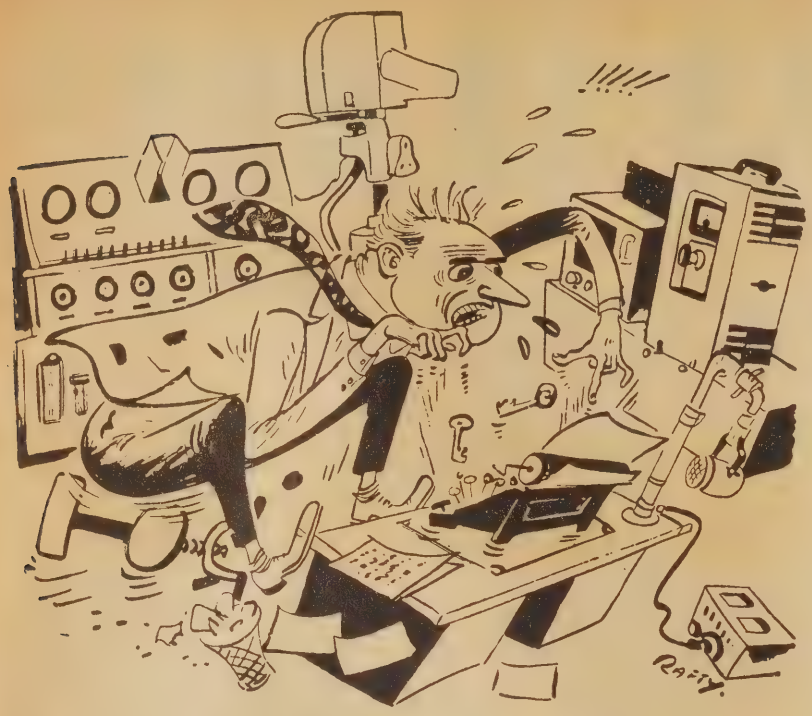


Let's Buy An Argument

A correspondent from Leeton, N.S.W., pulls an old chestnut from the fire with a series of questions about sidebands and modulation. I distinctly remember having argued this matter some years ago but, inasmuch as it will be new to other readers as well as to R.M., it will probably stand further discussion.

by Neville Williams

TO find what it's all about, I suggest that you digress for a moment and read the letter on the opposite page.

Read it? Good.

Now we can go ahead.

The whole subject of modulation, sideband generation and detection is one which many people find confusing. Some accept the hypothesis, though they don't understand it, and go on from there; some don't understand it and shy away from anything to do with it; some regard it with suspicion, or as a kind of mathematical trick, which has no real foundation in fact.

ROOM FOR ARGUMENT

It's no wonder that the subject is a fruitful one for argument.

R.M. starts off with the right idea when he says that modulation is akin to the theory of beat notes. Let's restate this as a first step:

When two signals are heterodyned or intermodulated, additional signals are produced at frequencies equal respectively to the sum and difference of the original frequencies.

As it occurs in a transmitter, in the process of amplitude modulation, a signal at audio frequency is superimposed on a radio frequency "carrier". The rule applying to heterodyne or beat notes applies.

Assuming the simplest case of a single audio modulating tone, we would therefore expect to find four distinct signals in the output circuit of a transmitter so modulated. These would be:

(1) The original audio modulating tone. Being simply audio, this cannot get beyond the modulating circuits and certainly cannot be radiated

(2) The original "carrier" frequency. Being a radio frequency signal, this can be handled and radiated by the output 'tank" and aerial system.

(3) The "sum" signal, equal in frequency to the carrier plus the particular audio frequency. Being also a radio frequency signal, this can be handled by the transmitter tuned circuits and radiated from the aerial.

(4) The "difference" signal, equal in frequency to the carrier minus the particular audio frequency. The same remarks apply as for the "sum" signal

From the foregoing, it is obvious that the output from a transmitter, modulated by a single audio tone, is three distinct radio frequency signals, which individually carry no hint of the audio tone which helped produce them.

AUDIO CONTENT

The audio content can only be deduced by noting their relative position in terms of frequency, their relative amplitude and their relative phase relationships.

And they DO exist in practice. With a sufficiently selective receiver, it is possible to tune the carrier and sidebands separately, as if they were plain C.W. signals, side by side in the spectrum. They can be heterodyned separately with a B.F.O. and observed separately on an "S" meter where suitable facilities are available.

If your knowledge of trigonometry goes a little beyond High School standard, the generation of sidebands can be demonstrated mathematically and the relevant steps are outlined in most advanced textbooks, including the traditionally famous Admiralty Handbook. So there it is; the beat note concept, actual observation and mathematical analysis all indicate that the process of amplitude modulation results in the production of sidebands. Further, that these sidebands are individual radio frequency signals in their own right, having frequencies equal to the sum and difference of the carrier and the particular modulating frequency or frequencies.

This being so, a conventional amplitude modulated station must occupy space in the spectrum equal in width to twice the highest modulation frequency.

A QUERY

All this fits together quite neatly but leads into an inevitable query:

If the foregoing is true, then the traditional drawing of a modulated R.F. wave must surely be a fabrication. But how can it be a fabrication when it is possible to see a modulated R.F. pattern on a C.R.O. face, exactly as per the said traditional drawing?

One can hardly charge an oscilloscope with prevarication or conspiracy.

Most people have seen such a pattern at some time or other. If the R.F. signal is low enough in frequency and the C.R.O. time base is equal to the task, it is even possible to display and count the individual R.F. cycles in the modulated envelope.

Where then are the sidebands?

Who is kidding whom?

The answer . . . . . nobody.

The output from a modulated transmitter or from a modulated oscillator DOES contain a carrier and at least two separate sidebands. What's more, we could see them as such, if care were taken to keep them separate by means of tuned circuits and display them on separate C.R.O. beams.

The number of cycles actually displayed would be a function of the time-base settings but it would not be difficult to demonstrate the difference in frequency between the relevant signals. With a little manipulation, it should be possible to depict such a relationship, as in figure 1a.

ALWAYS TOGETHER

BUT — and it is a very large but — we seldom, if ever, display the sidebands and carrier separately. We simply feed them together into the C.R.O., applying all three voltages simultaneously to a common amplifier grid and allowing them to dictate the instantaneous position of a common electron beam.

Now a grid cannot assume several different potentials at the one instant. It cannot simultaneously be at -1.0, -2.0 and -3.0 volts. It can only assume a single potential representing the resultant of all those applied to it at any one instant.

By the same token, a CRO beam cannot occupy several positions at the one time. It can only assume one resultant position and activate one spot on the screen at any one instant.

And this gives the clue to the apparent anomaly.

The carrier and sidebands do exist separately and can be separately observed wherever facilities exist to do so. They can be followed as separate frequencies through space, through the RF section of a receiver, through the IF channel after conversion and right to the demodulator or detector stage, where all RF components are finally supressed.

But, at any point in their journey, they can equally well be regarded and possibly displayed TOGETHER as a single resultant force. And when they are so regarded and displayed in combination, the RESULTANT has the pattern of a modulated envelope.

So there it is. In space, the carrier and sidebands do exist separately and can be treated as such. However, if a particular form or measurement or observation or calculation involves regarding them as a composite, then the resultant is equivalent to an RF carrier varying in field strength with modulation.

A RESULTANT

In the RF and IF system of a receiver, the carrier and sideband components are inevitably brought together and appear on individual grids as a composite resultant signal excursion. Plotted graphically on a time scale or displayed on a CRO screen, this composite resultant signal excursion has the form of a modulated envelope.

It is normally considered this way in a receiver. However, at any point along the RF or IF system, it would be possible to insert sharply tuned filters and isolate the carrier or sideband components which have constituted that envelope.

In other words, a modulated envelope pattern and a carrier plus sidebands are virtually one and the same thing. You cannot have one and not the other, because they ARE the same thing, viewed in a different way.

At the transmitting end, the avowed intention is to amplitude modulate a carrier but what emerges from the transmitter is, in fact, the original carrier plus a pattern of sidebands.

At the receiver, the intention is to apply a modulated envelope to the detector in order to recover the original audio content. However, it becomes apparent that it is impossible to have a modulated envelope at the detector unless the tuning circuits are broad enough to admit the carrier and the sidebands which form the envelope.

NO MODULATION LEFT

Put it this way, if you like, reverting to figure 1. The modulated envelope is formed as a resultant when all the signal components are added together. Take away some of the essential signal components — the sidebands — and you simply don't have left the means to constitute a modulated envelope.

What generally happens in practice is that the tuning circuits in a typical receiver attenuate the sidebands furthest displaced from the carrier and produced originally by the highest modulation frequencies. As a result, the modulated envelope pattern, as it is constituted at the detector, does not contain much high frequency modulation and therefore

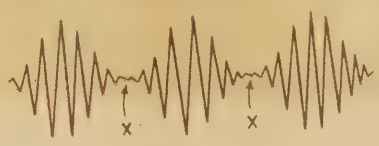
MORE PROBLEMS ABOUT SIDEBANDS

Dear Sir,

My problem concerns side bands. I am familiar with the fundamental theory of beat notes, how when a carrier is modulated with any frequency both sum and difference frequencies appear. But what I can't understand is why we must take these side bands into consideration at the receiving end. (I know, of course, from experience that we must, but why?)

Let us take a hypothetical receiver with theoretically perfect selectivity, and tune it to say 1 megacycle, unmodulated. The signal is rectified and appears as a voltage across the diode load.

Let us now modulate it, 100 per cent, with a tone of 1 kilocycle, so that it looks something like this.

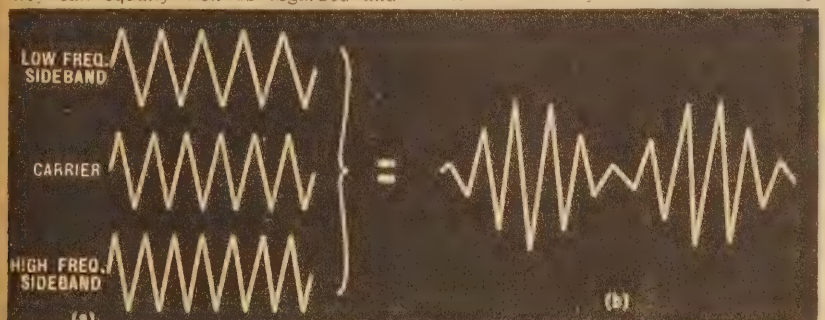


Now the voltage across the diode load is dependent on the received signal, so what maintains this voltage, at the places marked X, when the transmitter actually isn't radiating?

My own theory is that to even approach, in practice, prefer selectivity, we must use a tuned circuit with an extremely high "Q" factor. This circuit, once excited will maintain oscillation for many cycles; a damped oscillation, yes, but not very damped. On the peaks of modulation the tuned circuits get up a good old "swing" which carries them right through the trough with very little decrease in amplitude, and so a steady voltage, or nearly so, appears across the diode load, and not the required 1,000 cycles per sec.

This seems to me to be a simple and complete explanation yet any textbook I've seen places all the emphasis on the side bands themselves, "these side bands must not be attenuated or the modulation will be lost," when the real root of the problem is not attenuation of side bands, but a matter of Q factor and time constants. I know the two are inseparable, but it seems to me to be a wrong emphasis. Am I wrong?

Yours most sincerely,
R.J.M.



Carrier and sidebands can be regarded as separate RF signals having a particular position, amplitude and phase in respect to each other. When brought together at any point to produce a single resultant, they constitute a waveform which is immediately recognisable as a modulated envelope.

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Little General	April, 1957	U30-150	230/240	30	150	6.3V/1.7a
Simple Rx. for 3-Bands	May, 1957	U30-150	230/240	30	150	6.3V/1.7a
3-Band 3-Valve Rx.	August, 1957	U30-150	230/240	30	150	6.3V/1.7a
T.R.F. Economy Five	December, 1957	F60-285	230/240	60	285	6.3V/2a 5V/2a
Beginners Rx. (4 Valve)	June, 1958	U50-225	230/240	50	225	6.3V/2a
Junk Box Rx.	November, 1958	F60-385	230/240	60	385	6.3V/2a 5V/2a
RADIOGRAMS						
New Stand. Radiogram	May, 1957	U80-285	230/240	80	285/285	6.3V/2a 6.3V/2a 5V/2a
D/W Stand. Radiogram	July, 1957	U80-325	230/240	80	325/325	6.3V/2a 6.3V/2a 5V/2a
Economy Five	September, 1957	F60-285	230/240	60	285/285	6.3V/2a 5V/2a
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Western Australia: I. W Holman Perth BA8190.

Post this coupon to-day!

Please forward me details on National Power Transformers and National Filter Chokes.

NAME .....

ADDRESS .....

SUPPLIER (optional) ..... R.H. 1/59.

little high frequency audio appears in the detector's output circuit.

In a high fidelity receiver, with adequate pass-band through the tuned circuits, all the sideband components are retained and the modulated envelope, as it is constituted at the detector, is a complete replica of the envelope (or sideband pattern) radiated from the transmitter. Therefore, all the audio is recovered from the detector's output circuit.

In all, I suggest that that line of thinking hangs together fairly well — beat notes, sidebands and modulated envelope. It applies equally to the transmitting and the receiving end.

FLYWHEEL EFFECT

Now let's have a look at our correspondent's ideas about the flywheel effect in tuned circuits.

What he says may be well founded enough but I leave you to judge whether it actually helps much.

When an oscillatory voltage is induced across a tuned circuit it does not immediately disappear on removal of the energy which caused it. The oscillation persists and dies away to form what we call a damped wave-train. In circuits of high "Q", the wave train is sustained for a longer period than in circuits of low "Q".

When it is desired to pass a modulated signal through a series of tuned circuits, one has to consider whether the damped wave-train will subside quickly enough to allow the signal voltage across the tuned circuit (or circuits) to follow sharp reductions in amplitude, caused by substantial high frequency modulation.

This problem is not confined to the receiver but applies also to any tuned circuits in the transmitter, which have to handle a modulated envelope, and to the transmitting aerial itself, which is a resonant circuit, for all its bulk.

If the Q factor of any of the transmitting circuits is excessive, the higher modulation frequencies will simply not be present in the radiated carrier.

Similarly, if there are too many high-Q circuits in the receiver, high modulation frequencies which may be present in the radiated signal, will not reach the detector.

It follows that, in both the design of the transmitter and of the receiver, it is necessary to watch carefully the number and the "Q" factor of the tuned circuits through which the signals must pass.

And having said as much, it becomes apparent that we have arrived back more or less at the point where we started. Keeping a careful check on the number and "Q" factor of the relevant tuned circuits is simply keeping a careful check on overall selectivity.

You see, circuits which would tend to sustain oscillatory voltages and ignore modulation:

IN DIFFERENT ORDER

(1) Have a high effective "Q" factor, therefore

(2) Exhibit high selectivity, therefore

(3) Tend to exclude some of the sideband energy from which the required modulated envelope is constituted.

These statements can be swapped around in different order, if you don't like the way I have them, because they are all expressions of the one basic condition.

"CONTRA-POLAR ENERGY" AGAIN

Dear Sir,

I read with interest H.T.'s letter from Singapore. It seems to me he has his name and source of power mixed.

The energy he probably means is CONTRA TERRENE MATTER not "Contra Polar" as he terms it.

The existence of this matter was proved in 1953 by photographic plates being developed after an altitude of twenty miles was obtained.

The evidence showed that a terrific nuclear explosion had taken place approximately fifty million times larger than the energy of a splitting Uranium atom.

The cause of this explosion was a negative proton from space striking a normal positive proton in the plates. The Contra-Terrene name was given to this negative proton but, as for H.T.'s idea of turning lamp light black I very much doubt. As for generating it, well as soon as one was formed a complete annihilation of the machine would take place and everyone with it!

Hoping this will shed some light on the matter.

Yours faithfully, A.W.

I imagine it would be quite possible to frame a complete discussion of transmission and reception on the concept of tuned circuit "Q", without as much as mentioning sidebands. But could we afford to have students ignorant of sidebands, seeing that other aspects of electronic theory demand an examination of inter-modulation effects?

And if sidebands have to be mentioned, then is it not wiser to make them the foundation of discussion, as is normally done, rather than hang the whole thing on circuit "Q"?

I'm afraid that I can't go with our correspondent's suggestion of mixing the two. He apparently wants to talk about sidebands at the transmitting end and circuit "Q" at the receiver.

It appeals to me as a classic example of changing horses in midstream, with all the attendant hazards of so doing.

Nor can I take his final paragraph very seriously. While saying that the phenomena are inseparable, he says that "the real root of the problem is not attenuation of sidebands but a matter of Q factor and time constants."

CANNOT BE SEPARATED

It may be easier for him to think of one aspect rather than the other but no single aspect can justifiably be separated from another and branded as "the real root of the problem." And even if it could, I doubt whether it would be the one suggested.

Going now from the sublime to the ridiculous, you may remember that we published a letter some months ago from a reader in Singapore. He had been vastly intrigued by an article describing what he called Contra-Polar energy, which was the "reciprocal" of ordinary electricity.

When passed through an electric light globe, it would produce darkness instead of light.

When passed through an electric kettle, it would freeze the contents instead of heating them.

And so on.

Though it was obvious enough that our correspondent had been the victim of some kind of technical "leg pull," I wasn't sure by whom and for what purpose. However, quite a few readers phoned me or wrote to say that they recollected such an article in an April issue of an American technical magazine, though they couldn't recall which one.

American magazines in the popular technical field seem to be rather fond of this kind of thing, though they usually take the precaution of reminding the reader at the end of the article that April 1 has a certain significance.

I recall an article pre-war where this precaution was not taken. If I remember rightly, it had to do with the supposed invention of a valve requiring no filament power, which was being suppressed by connivance between the wicked, scheming valve makers.

The exaggerated terminology, intended to amuse, succeeded only in inciting and many readers responded spontaneously with letters which didn't exactly amuse the public relations officers of the said valve companies.

A SPOT OF LEVITY

In short, I don't blame technical writers for indulging in an annual spot of levity — I've been tempted to do likewise myself — but it is important to see that all and sundry do appreciate the article for what it is, even if not until the last paragraph.

Our correspondent from Singapore, quoted earlier, is a case in point. If a relative newcomer to the field of electronics, how is he to appreciate that statements made in an authentic looking article are really rubbish?

A joke only becomes such when the person involved realises that his leg is being pulled in the metaphorical sense. It becomes doubly enjoyable if he can admire the deftness and artistry with which it is being done.

After all, if I were to compose an article in the role of Professor R. U. A. Zleepe, filled with big words from a medical textbook and propagating some preposterous story about body tissue, what radio serviceman could be expected to know automatically that it was a fake? It's right outside his normal field of thinking.

And so it is that another correspondent, having possibly smiled at the naivity of the reader from Singapore, launches into a serious exposition of what was probably the same hoax article!

I can only suggest that A.W. have a conference with his tailor to see whether, in fact, either one or both of his legs have also been distended by "pulling."

But, of course, in saying this, I'm leaving myself wide open. Wouldn't my face be red if it transpired that there was such

(Continued on Page 112)

FOR THE BEGINNER!

a simplified TV kit

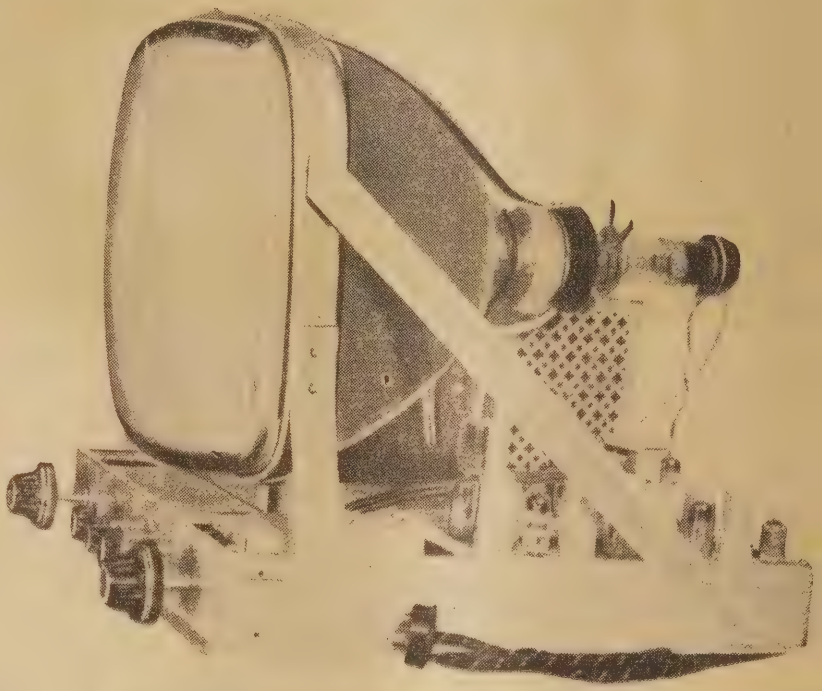
The latest "R. TV & H." set in a form which even the beginner or handyman can make at a terrific saving.

In response to the many inquiries received for an "easy to build" version of the "R. TV and H." Set, we present this simplified version of the latest circuit as an addition to our existing range of TV units.

All intricate sections, such as IF strip, EHT section, commercial tuner, etc., are assembled and wired. Resistors and condensors are already mounted and wired to mounting panels. You have only to mount the main components and make a few soldered connections. There is a big, profusely illustrated instruction book supplied with each kit.

The average handyman, spending an hour or so at night can make his own 17in or 21in set in less than a week. Sample chassis is on view at our premises. You may bring yours along and copy our model if you wish. Each kit includes only first-grade branded components. Complete with all valves and AWA 17in or 21in picture tube. The IF's are Q plus using the latest "R. TV and H." IF strip circuit. The ready drilled chassis is first cadmium plated then passivated to avoid finger marks. Tuner is Philips and deflection components AWA. The whole project is essentially one where quality of design, materials and craftsmanship are dominant.

If you've interested in owning a TV set, with a saving of £100 or more, send coupon NOW for full details.



NOW ALMOST ANYONE CAN MAKE HIS OWN TELEVISION SET!

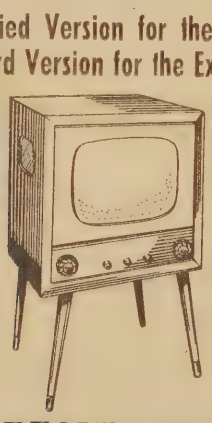
- Simplified Version for the Beginner
- Standard Version for the Experienced

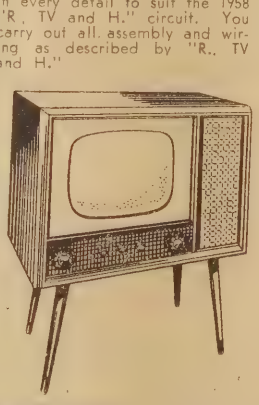
STANDARD KITS FOR THE EXPERIENCED

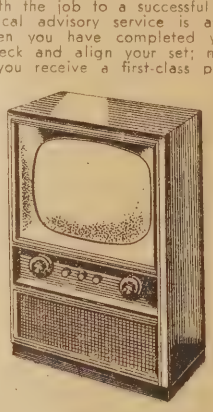
Complete kits for the technician and hobbyist with some experience are readily available. These kits are complete in every detail to suit the 1958 "R. TV and H." circuit. You carry out all assembly and wiring as described by "R. TV and H."

OUR CHECKING AND ALIGNMENT SERVICE GUARANTEES FIRST-CLASS RESULTS

Clients are GUARANTEED a first-class picture. The moment you purchase an E.P. kit, either simplified or standard, we guarantee to see you through with the job to a successful conclusion. Our technical advisory service is available to you. When you have completed your wiring we will check and align your set; making certain that you receive a first-class picture.







THREE BEAUTIFUL CABINET DESIGNS

For those who prefer to buy a ready-made cabinet we have produced three very fine cabinets as illustrated.

SEND COUPON NOW FOR FULL DETAILS

TO ELECTRONIC PARTS PTY. LTD.

Dear Sirs,

Please mail me free literature on TV kits.

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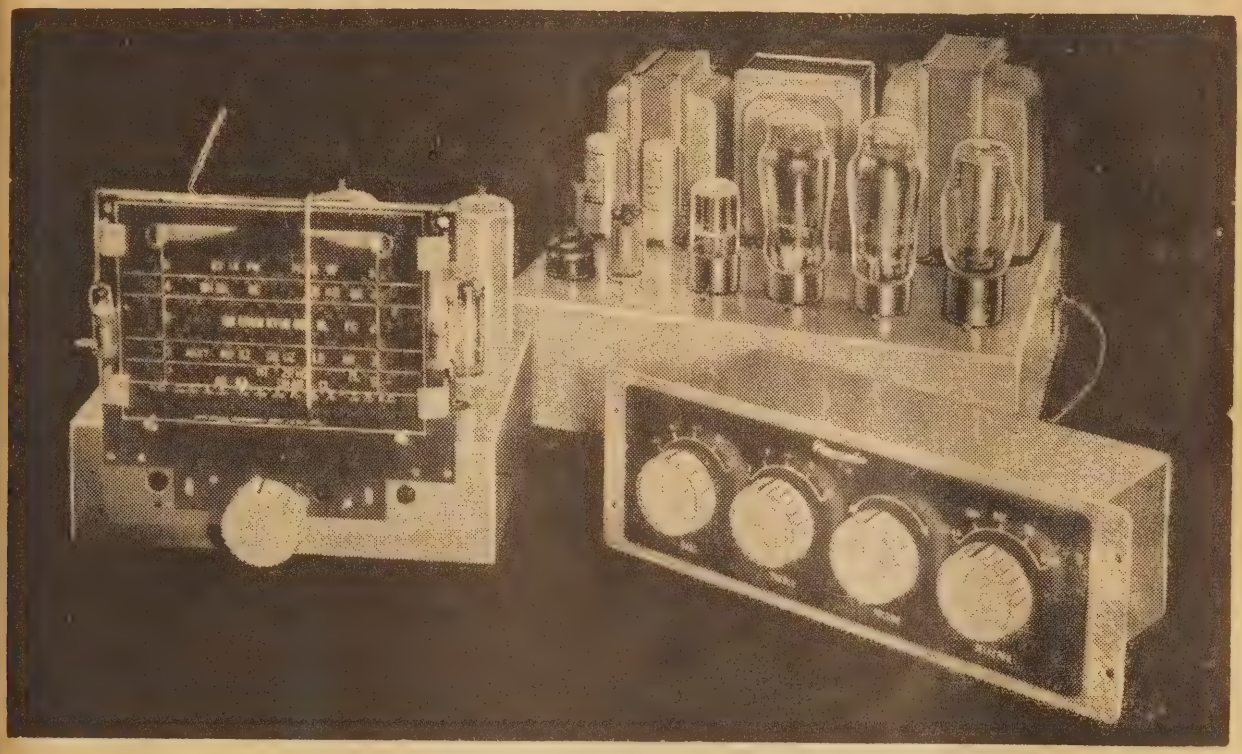
ELECTRONIC

E. S. & A. BANK BUILDING (opp. Grace Bros. B'way.)

BUILD IT YOURSELF!



BUILD YOUR OWN HI-FI OUTFIT

PLAYMASTER HIGH FIDELITY AMPLIFIERS TUNERS CONTROL UNITS

Designed by "Radio, Television and Hobbies" this high-grade equipment offers combinations of units to suit every requirement. Quality of reproduction on performance and figures is amazing. Furthermore, the cost is much lower than that of similar powered imported units. If you prefer to build your own hi-fi gear, we can supply the kit of parts containing precisely the same high-grade components as are used in the completely built unit.

The range includes high quality amplifiers from 17 watts to 5 watts, control units, and a complete range of tuners (including the latest F.M. tuner). You are invited to write, phone or call for illustrated descriptive catalogue.

SPECIAL! **A COMPLETE HIGH-GRADE PLAYMASTER OUTFIT FOR UNDER £50**

If you are keen to obtain hi-fidelity reproduction, something much better than could be expected from even the more expensive radiograms, this genuine hi-fi outfit will appeal to you. It comprises Playmaster 5/6 watt-amplifier (available as a kit or completely built), the sensational Magnavox 12 WR twin cone speaker and latest Dual record player. Operated from a suitably designed cabinet, it gives truly superior quality reproduction of your recordings. Send now for Playmaster catalogue.

STEREO AMPLIFIER

Interest is growing rapidly in stereophonic sound and we are happy to announce that kits or completely built units are now available for the STEREOPHONIC AMPLIFIER designed by John Moyle ("Radio, Television and Hobbies," July, 1958). STEREOCRYSTAL CONTROL UNIT ("Radio Television and Hobbies," October, 1958), and STEREO PICK-UPS and CARTRIDGES ALSO AVAILABLE. Send coupon for price and all details on items required.

PARTS Pty. Ltd.

TO ELECTRONIC PARTS PTY. LTD.

Dear Sirs,
Please mail me your free catalogue describing

☐ *Playmaster Hi-Fi* ☐ *Stereophonic Amplifier* ☐ *Stereo Crystal Control Unit etc.*

NAME.....

ADDRESS.....

TRADE REVIEWS AND RELEASES

PHILIPS P81700 METER HAS ADVANCED FEATURES

With a sensitivity rivalling a normal valve voltmeter, the recently released Philips multimeter type P81700 includes all normal DC, AC and ohms ranges plus AC current ranges. Internal resistance is 40,000 ohms/volt full scale deflection on the DC ranges. A foolproof overload protection system is included.

The instrument is housed in a case approx. 7¼in by 5¼in 3in. Batteries for resistance ranges are mounted internally. One type 950 1.5V cell is required and one type 412 22.5V battery.

RELIABILITY and ruggedness sufficient for a bench multimeter have been achieved in a 25 uA basic meter movement by means of a novel torsion-type suspension. This results in a compact instrument, independent of the the power mains which is useful for many of the jobs outside the scope of a normal 1,000 ohms per volt meter such as AVC line and RC amplifier measurements. On the 120-volt range, for example, the resistance is nearly 5 megohms.

Overall dimensions of the new instrument are approx. 7¼in by 5¼in by 3in. It reads from 0.6mA to 3A and from 3V to 1,200V full-scale deflection both AC and DC. There are also 0.12mA and 60 mV scales for DC only. Internal resistance is 1,666 ohms per volt on the AC ranges.

Resistance ranges permit measurements between 0.5 ohms and 10 megohms with the internal batteries.

Damage due to overload is avoided in the P81700 by connecting a pair of rectifiers with opposite polarities each in parallel with the meter movement. Meter and rectifier characteristics are chosen so that currents exceeding full-scale meter deflection are progressively shunted by the rectifier and heavy overloads will not damage the movement.

Since the overload protection is instantaneous and automatic the movement is most unlikely to be damaged in normal use. The system does not operate for the 60 mV range, a minor disadvantage since it is used less frequently than other ranges.

We accepted an invitation from Philips to test the instrument under conditions of overload but with the most severe maltreatment we could bring ourselves to inflict, we were not even able to shift the zero setting.

Frequencies between 30 cps and 10,000 give accurate readings for voltage and current except in the case of the 1,200 volt range where the upper limit is 5,000 cps. A dB scale covering a range of 22 dB will be found most useful for tests on audio equipment generally.

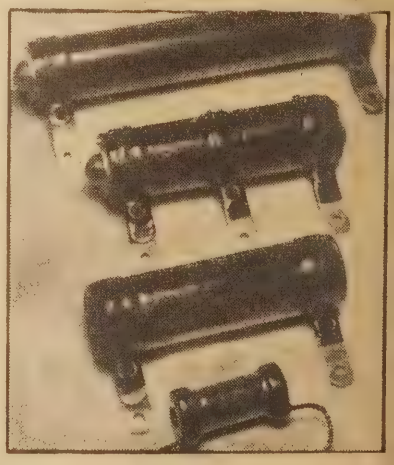
Our first impressions of a compact instrument with a generous, easy-to-read scale, were confirmed during the several weeks that the review sample was in use in our laboratory.

Accuracy conforms with the usual B.S.I. industrial standards being 1.2 per cent of F.S.D. on the DC ranges and 3.5 per cent on the AC ranges.

The price is £29/15/6 plus 12½ per cent sales tax where applicable. Inquiries should be directed to Philips Electrical Industries P/L, 69 Clarence Street, Sydney.

MERLIN W.W. RESISTORS

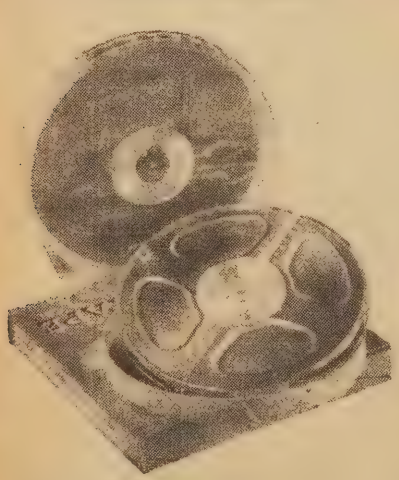
SAMPLES from the range of "Merlin" wire wound resistors made by Zephyr Products Pty. Ltd., of 58 High Street, Glen Iris, Victoria, were recently passed to us through Jacoby Mitchell and Co. Power dissipation ratings between 3w and 30w are available in a



wide range of values up to 300,000 ohms for the largest size.

High reliability is achieved under conditions of shock, vibration or humid and salty atmosphere. All terminations are brazed while close grained ceramic materials are used for the formers. Eight coats of tropic-proof enamel completely surround the resistive element which is rated to work at maximum dissipation up to 150 degrees C.

Pig tail and solder lug terminations are available and mounting may be by means of end feet for the horizontal position or a brass centre plug for vertical mounting.



MAGNETIC RECORDING TAPE FROM E.M.I.

TAPE users will be pleased with the neat and practical plastic case provided to house "Emitape" Magnetic recording tape spools. The tape is available in 5in and 7in spools and in standard (.0016in) and long play (.001in) thicknesses. Oxide coating thickness for each tape is .0005in. A 7in spool of LP tape contains 1,800ft.

A PVC base is used and the manufacturers claim excellent mechanical and electrical properties which would appear to be substantiated since the tape is widely used commercially. A standard feature is a metallic contact strip at the end of the reel to operate the automatic stop on certain recorders.

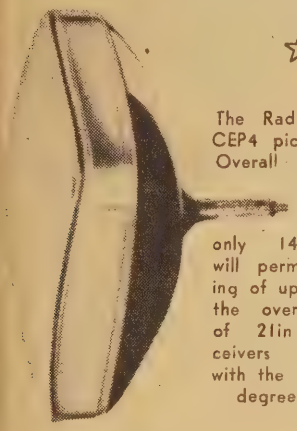
Further information is available from E.M.I. (Aust.), 301 Castlereagh Street, Sydney

AWV PICTURE TUBES

21CEP4 AND 17BXP4

BOTH of the new Radiotron picture tubes employ 110 degree deflection They are of rectangular, low-voltage electrostatic and magnetic deflection type, with a filterglass faceplate, and aluminised screen. These tubes use the new "straight" electron gun assembly with an improved focusing lens system to maintain image sharpness over the entire screen area. No ion trap magnet is required. An integral glass-button base is used, having straight-through leads fitted with a moulded indexing plug. The tubes have the usual external conductive bulb coating which forms a supplementary filter capacitor with the internal coating.

The overall length of 21CEP4 is only 14½in, with a neck length of 5½in This represents a saving of approximately 4in



The Radiotron 21-CEP4 picture tube. Overall length is only 14½in. This will permit a saving of up to 4in in the overall depth of 21in TV receivers compared with the present 90 degree tubes

in depth compared with the previous 21in 90 degree tube (21CBP4). At the same time the minimum screen area of 262 square inches is maintained, providing a picture approximately 15in x 19in. The small neck diameter of 1⅛in permits the use of a deflection yoke of high sensitivity, so that deflection of the beam through 110 degrees requires little more power than was required in earlier 21in tubes for 90 degree deflection.

The features of the 21CEP4 mentioned above apply equally to the 17BZP4 The overall length of only 12½in, including neck length of 5½in, represents a saving of approximately 2in in depth compared with the previous 17in 90 degree tube (17BJP4).

FERGUSON AD. ERROR

AN error occurred in the advertisement for Ferguson Transformers Pty. Ltd., of Ferguson Lane. Chatswood. N.S.W., which appeared in the December 1958 issue.

Type TRS108 and TRS109 were incorrectly recommended for the Intercomm Amplifier and the RCS portable respectively.

For the Intercomm. amplifier described in Radio, Television and Hobbies dated June 1958, the correct Ferguson transformer is type TRS109. The RCS transistor portable with RCA transistor operates correctly with output transformer type TRS108.

COSSOR OSCILLOSCOPE IN KIT FORM

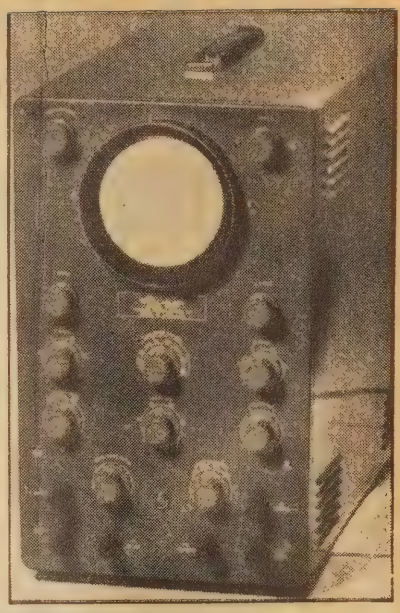
FOLLOWING the valve voltmeter (reviewed March 58) we were very interested to use in our own workshop an oscilloscope built from a Cossor kit. The instrument is a single beam type using a 4in diam. flat-faced cathode ray tube. The vertical amplifiers are within 3 db between 5 cps and 3 Mc and usable up to about 7 Mc.

The instrument performed in the excellent manner we have come to expect of Cossor CROs, all controls working smoothly and easily. The focus was very sharp and the pattern free from spurious deflections.

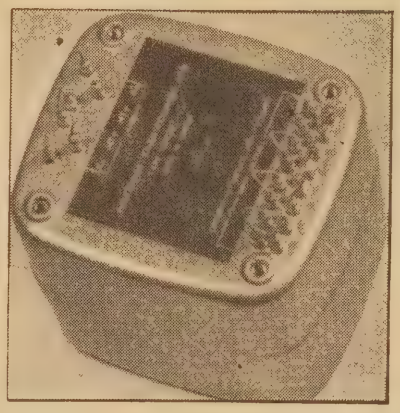
We were particularly impressed by the beautifully produced instruction manual which gives detailed drawings of parts and sub-assemblies, bringing the construction of the instrument almost within the scope of a beginner.

Some readers may feel that the case and chassis construction is a little on the light side but on the other hand it is very convenient to have a 4in CRO weighing only 18lb around the workshop.

The price is £74/17/6. Jacoby, Mitchell & Co. of 477 Kent Street, Sydney will be glad to supply further information.



QUALITY IMPORTED OUTPUT TRANSFORMER



PARTRIDGE transformers are known throughout the world for their high quality and are now represented in Australia by Simon Gray (Radio Division) Pty. Ltd., 28 Elizabeth Street, Melbourne. Among the types available is the CFB/0/0.95 having a primary impedance suitable for the 17-watt Playmasters.

Tested in this amplifier, the transformer exhibited a very high standard of frequency and power response, good enough to satisfy even the very critical. Our circuit constants as published need not be changed for this transformer

Partridge transformers are also available for other circuits such as the Mullard 20-watt amplifier. Their finish is in keeping with a first quality product.

Simon Gray can supply full details of the Partridge range.

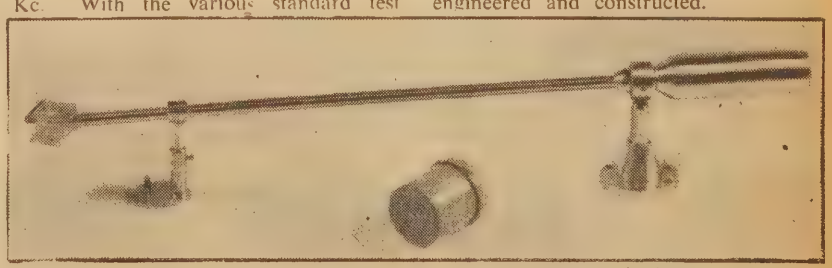
COMMONWEALTH ELECTRONICS PRODUCE PICKUP

THIS Australian designed and built pickup has been widely used by broadcasting and TV stations.

The pickup was tested in our own laboratory and its performance found to be extremely good Its resonance is well damped and in the vicinity of 20 Kc. With the various standard test records, its waveform is virtually free from distortion over the full audible range and even beyond.

Frequency response for all practical purposes is quite flat throughout the audible range.

The pickup arm has been carefully engineered and constructed.



The list price of the Commonwealth Electronics pickup is £25/12/0 including tax, the matching transformer and diamond stylus. Normal stylus pressure is 6 gms but the pickup will track satisfactorily down to 3 gms.

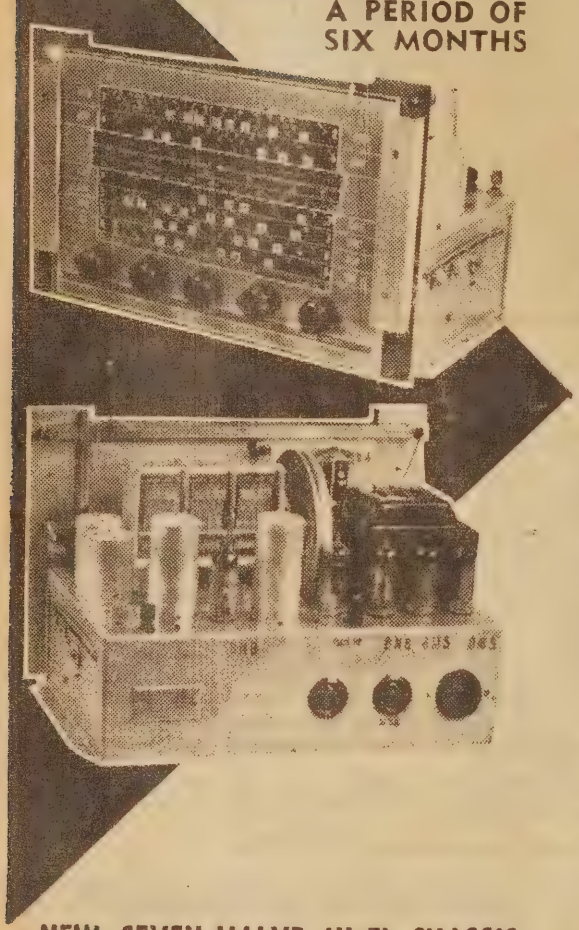
before purchasing your radio see our—

Hi-Fidelity

RANGE

and compare these NEW features..

ALL CHASSIS GUARANTEED FOR A PERIOD OF SIX MONTHS



NEW:

Ultramodern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short wave range of 12,000 miles. All valves used are the new Mullard nine pin Innovar series.

NEW:

Ton control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving plus or minus 15 db boost or cut at 50 cycles L.F. and 10,000 H.F., combined with push pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourites recordings.

NEW:

Dual Speaker combination, using a heavy duty woofer (12in M.S.P. Jensen AU54 special) with matching 6in tweeter and cross-over network giving a frequency response of 46 to 13,000 cycles. Speakers are mounted coaxially making only one 11in mounting hole necessary.

NEW:

If required the new Magnavox high-fidelity twin coned speaker can be supplied. Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations of each State in prominent type. Dial fitted with counterweight drive giving smooth tuning. Indicator lights are fitted showing which band is in operation. Dial can be supplied in cream, black or brown with matching knobs and escutcheons to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis also pick-up terminals and outlet for gram. motor.
Power switch is fitted to volume control, radiogram switch, combined with wave change switch. Audio end of set can be used with TV receiver if required.

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT Frequency response 40-13,000 cycles Max output 10 watts.

£41/15/0 F.O.R

A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications are nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

£44/15/0 F.O.R

NEW SEVEN-VALVE HI-FI CHASSIS

This new compact dual wave seven valve chassis uses the same tuner circuit as our 9-valve unit with the Mullard tone-control circuit giving separate bass and treble controls. Push-pull output using two of the new 6BM8 dual purpose output valves and heavy duty M.S.P. speaker

£31/15/- F.O.R. PACKING 10/- EXTRA

Also available with Magnavox 12W.R. Hi-Fi speaker and Ferguson output transformer at £4/15/- extra.

Write for full specifications

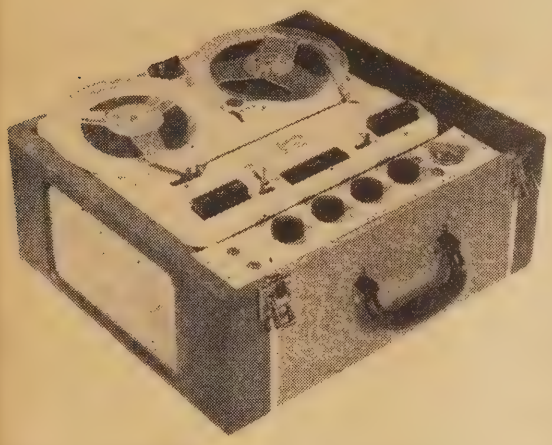
ALL 4 SPEED RECORD CHANGERS AND PLAYERS STOCKED

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145

Buying a Tape Recorder?

First see and hear the new Hi-Fi Recorder by Classic incorporating the new Collaro Mark IV Transcription deck. The only deck with ALL these features.



THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE PLASTIC-COVERED CASE COMPLETE WITH ACOS MICROPHONE AND FITTED WITH DUAL ROLA SPEAKERS

The six-valve amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Record monitoring and outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck.

- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
  Instantaneous changes can be made from one track to the other. Fast rewind in either direction.
- **CONSTANT TAPE TENSION**
  A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
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OFF THE RECORD — NEWS & REVIEWS

Stereo finally came officially to the Australian public with the release of one make of radiogram and half-a-dozen stereo records. It was hardly an auspicious beginning to a new era in sound. Indeed during the last few months one wonders whether the industry is scared stiff of stereo or doesn't know what to do with it.

by John Moyle

I CAN well believe there have been many difficulties to be faced by the recording and radiogram people in Australia, problems of supply, production and so on.

But, compared with the attitude of the trade overseas, in both England and U.S.A., the Australian approach is hard to understand.

It is essentially true to say that those who have tried to explain stereo to the public and to show what it can do, have been people outside the recording industry.

A notable exception to this would be Westrex, the company which did so much work in developing the 45/45 cutting head used extensively in America.

Nor has any direct information or assistance been available from the local recording companies concerning the new technique. Acquaintance with stereo in Australia has come from overseas reports and publications, practical experience gained from locally built equipment and, until recently imported records.

One or two record companies haven't been at all happy about information published on stereo, even in our own magazine.

They consider much of it has been ill-informed, premature, and "little more than gossip," to quote one unofficial spokesman. That is very much a matter of opinion. Here is a development, likely to become one of the most important in the history of sound reproduction. It has been approaching us with agonising slowness for about 18 months. It is of the greatest interest to all audio enthusiasts and awaited by them with tremendous anticipation.

Could anyone imagine that a magazine would fail to gather as much information and report as it could, and from as many sources as possible? If it comes to that, wouldn't the best and most printable information be that issued by the people who were doing the work of producing records, if only it had been available in place of the inevitable "no comment"?

MEDIUM PRICED STEREO

I can't regret a single word of what I have written or reported, or anything I have done with stereo in the last 12 months. For most of our readers, it was the only information about stereo they were able to gather in.

I do regret very much that the record industry has, for one reason or another, felt unable to give a more positive lead from its own resources, and even now is not helping the public to be fully enthusiastic about this wonderful new development.

One good feature—and I don't mean there is only one — about the initial release of the H.M.V. stereo is the fact that it is not excessively priced.

If you consider that a really good radiogram as previously cost well over £100, and could not under present conditions well be otherwise, £145 including two dual loudspeaker systems and cabinets is not really a high price. In particular, one can buy the main unit for much less, and add the second loudspeaker at a later date.

There is still a feeling in the minds of the general public that stereo must be costly, must be hi-fi and must be beyond its reach. Other than the fact that anything which calls for extra components must cost more than an equivalent single channel arrangement, none of the above assumptions are true.

GOOD CRYSTALS

Radiograms have always come in various shapes, sizes and prices, and there is no reason why the addition of stereo should not apply to them all.

Naturally the best stereo will always be the most elaborate and costly, but this applies to almost anything.

It is fortunate that the comparatively simple crystal stereo pickups, now freely available, are so good.

Recently I was able to observe some tests made on a popular type, including frequency response and channel separation checks. The crystal unit, operated into the correct load, was acceptably flat from 40 cycles to 10KC.

Its separation was quite up to manufacturers ratings and much better than a highly respected—and priced—imported pickup of the magnetic type.

It held excellent separation over the entire significant range and, at its best, was better than 20db.

In fact the challenge of stereo has caused designers to completely overhaul their techniques and standards, so much so that we can expect much improved performance from crystal and ceramic cartridges from now on. Undoubtedly, we will also see many fine magnetic and moving coil pickups but they will not be cheap.

DIAMOND STYLII

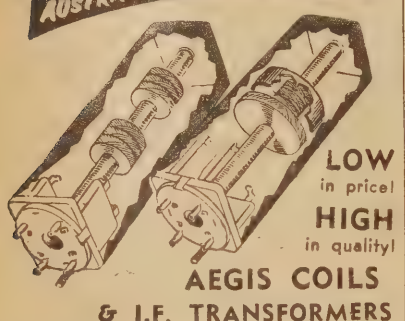
One good point about stereo pickups in general is the final acceptance of the diamond point as a standard item.

The lower initial cost and reasonable life of the sapphire held back the diamond point for many years, but quantity production and better factory methods have changed all that.

My own experience has been that, particularly with the modest arms and weight compromise, which so often goes with crystal pickups, the sapphire point is hardly worth considering for stereo.

As soon as appreciable wear appears, degraded performance and high record wear are inevitable.

I doubt whether any commercial radiograms will find their way to the market



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A JOURNEY INTO STEREO SOUND. — Demonstration Stereo Disc. Decca SKLA 4001.

Stereo is now upon us, and I'm sure every owner of an equipment is going to invest in at least one of the special demonstration discs which have proved so popular overseas.

They are popular because everyone wants to hear just what stereo is like when applied to a wide variety of sounds, and normally this wouldn't be possible without buying a large number of records on spec.

To the recording companies, such discs are their showcases, for its pretty certain they have searched their archives at the time of issue, and selected the best examples of their work.

In addition, all these records have included various sound effects which are not normally sold as discs, but which, through their novelty and effectiveness are likely to sell more stereo than any others.

A rushing train, for instance, will show the essentials of stereo—its ability to separate sounds to either side of the room, and at the appropriate time to blend them in the middle — probably more effectively than anything else. At least I have found this in all the demonstrations I have given, public and private.

Nothing has caught the imagination, or clicked more solidly in explaining what stereo is, than these self-same trains.

Of this Decca disc, I can only say that it contains some of the best stereo I have ever heard.

With due respect to the efforts of other firms, I think it has proved more successful and has received more universal acclaim than any other.

Its novelties include trains, both slow and fast, and some shattering noises from racing cars. Musically the band presenting Ansermet rehearsing the Swiss Romande orchestra was a stroke of genius on the part of someone. Then there are some popular band numbers, Vera Lynn, Winifred Atwell, Wilhelm Backhaus, Kirsten Flagstad, a massive selection from Mantovani, and a magnificent excerpt from Die Walkure.

The disc technically is a triumph for Decca, and eloquent proof that it is still able to make outstanding engineering contributions to the recording art.

It has an almost completely silent surface, which is more than can be said for many of the earlier stereo discs I have acquired. Most people would agree that it sounds every bit as good as the best single channel records, apart from the stereo effect which is equalled by few others.

This was the disc which finally convinced me that stereo just couldn't fail. It shows how good it can be, and if Decca or anyone else can make one as good as this, we can expect them all to be of equal standard before very long.

Incidentally, I have compared the Australian pressing with an English copy I have had for some time, and I doubt whether it would be possible to tell one from the other.

In brief—eloquent testimony of things to come. The first five-star for stereo.

---

without diamond points, and everybody stands to gain by their use. The price of stereo discs in Australia appears to have been set initially somewhat higher than for monaural discs by the major manufacturers. This is not so in England where the prices are the same.

But at least one Australian company, namely Festival, has announced a price of 55/ for a 12-inch disc, and can call upon both America Decca and Vox as program sources.

It is likely (and desirable) that eventually all Australian prices will fall to a comparable figure, otherwise the record buying public can be excused for classing stereo as a luxury line.

When production climbs, as it must, there should be very little extra cost involved in a stereo disc. At the moment, rejects from the presses might be abnormally high.

★ ★ ★

LA BELLE FRANCE—Carmen Dragon and the Capitol Symphony Orchestra. (Marseillaise, Softly Awakes My Heart, Premiere Arabesque, Polonaise from Mignon, Frere Jacques, Waltz from Coppelia, Can-Can from Orpheus In The Underworld, Alouette. Paree!. Sur le Pont d'Avignon, Faust Waltz.) Capitol P-8427.

The style of Carmen Dragon is rapidly earning recognition along with that of other famous arranger-conductors.

His formula is a particularly simple one. It is completely intelligible, rarely unconventional, free from irritating gimmicks, and with a tuneful quality which wears well.

In fact, he makes use of most of the styles of other bands, but when he does come up with a catchy progression or unusual resolution, he is careful not to run it to death.

Despite the wide range of the music, nothing suffers much in the arrangements except, perhaps, the Marseillaise.

It sounds very good and audiences will love it, but I doubt whether the Frenchmen themselves will approve.

They are generally far too occupied with the effect of it on their emotions to do other than play it very straightforwardly, indeed. No special arrangements and harmonies for them!

It's a clean, bright and resonant recording, which should go over well.

But don't be fooled with the progression of numbers as mentioned on the jacket. There is an obvious transposition

★ ★ ★

LIEDER WITH ORCHESTRA—Grieg; Solvieg's Song, Solvieg's Lullaby, A Swan, Last Spring; sung by Annelies Kupper with the Munich Philharmonic Orchestra conducted by Fritz Rieger. Richard Strauss; Dedication, I Carry My Love, Secret Invitation, Cecilia, sung by Peter Anders with the Munich Philharmonic Orchestra conducted by Fritz Kehman. Wagner; Wesendonck Lieder, sung by Astrid Varney with the Bavarian Radio Symphony Orchestra, conducted by Leopold Ludwig. DGG LPEM 19059.

It is rather unusual to have a record of Lieder sung by three different artists, each favouring a different composer.

It's not a bad idea, particularly when

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the singers are of top quality. Two solid sides of the same voice can be hard to take, no matter how good the performer.

On this record we have in fact three short song recitals and we can listen to them singly or as a group.

The singer of the Grieg is new to me. She has a dark toned voice for a soprano, and her singing an air of deep tragedy rather than of sweet nostalgia which is the mood we hear most.

She does in fact invest an unusual quality of dignity to Grieg which lifts the music to a larger stature

Her voice has a lovely quality and considerable dramatic power, both heard most effectively in the Swan — truly magnificent singing.

Peter Anders wins high praise with a group of well known Strauss songs.

His voice is light in weight, and records with a rather shrill quality in the top register, the more so in contrast with the soprano who preceded him. It is well controlled and it has a clear ringing quality which any tenor would envy.

Astrid Varnay's contribution is the least familiar musically, but as she is one of the finest living Wagnerian sopranos her performance is worth the full side it occupies.

These songs were written about the time of Tristan, and the mood is the same. They were the result of one of Wagner's love affairs with Mathilde Wesendonck and I doubt whether they have ever been recorded previously.

I greatly admire the technical standard of this record which is every bit as good as the singing. What a boon is a good DGG surface. Those beautifully quiet moments in the Wagner, for instance, would have been shattered against anything but complete silence.

It is vocal recording at its best, and its best is magnificent.

★ ★ ★

CHOPIN. — Les Sylphides. TCHAIKOWSKY. — Sleeping Beauty. Played by the Paris Conservatoire Orchestra conducted by Roger Desormiere. Ace of Clubs. ACLA 8.

This is a new label issued by the English Decca company, probably as an answer to the cheaper discs obtainable through the record clubs whose activities are extending to this country.

Every recording company collects quantities of good material which, for various reasons, it is not able to work into its standard price catalogue.

These reasons are often those of expedience rather than technical inferiority and if a suitable marketing method can be found there is no reason why this material should not be used in a cheaper field. It is obviously not practicable to use first choice recordings for the purpose.

It is not surprising, therefore, if I do not class this as the best version of either ballet, for practically every recording company has a really fine example currently available.

Anyone with an ear for a French oboe will pick the nationality of the orchestra in Sylphides, for it has a characteristic shrillness of tone.

In fact, preoccupation with the upper registers will probably cause many people to apply top cut to the record, particularly Sylphides.

It is as though extra pre-emphasis is inbuilt to the recording.

It will be interesting to note how the Ace of Clubs catalogue builds up, as there must be a pile of good stuff which can be offered at a bargain price.

★ ★ ★

TCHAIKOWSKY.—Swan Lake Excerpts. Played by the Ballet Theatre Orchestra conducted by Joseph Levine. Capitol P-8416.

Anyone not familiar with Swan Lake music might be excused for wondering what goes on as he turns from disc to disc, all bearing the name of this famous ballet.

I doubt whether I have ever heard two records of "excerpts" which present the same music or in the same order.

It doesn't particularly matter, for the Swan Lake is equally beautiful in any form or any order, and purists always have the complete version by Mercury to fall back on.

I haven't heard of the Ballet Theatre, not being a fervent balletomane, but apparently it is a well-known organisation in America and it certainly has a good orchestra.

Capitol's sound is characteristically clear in its outlines and that is my chief reactions to this disc. It hasn't a great deal of reverberation nor is it particularly forward, but if you are really listening, you won't miss very much.

As usual, the "kitchen" is heard particularly well, if not too well.

The sound is not as full or as glamorous as the Philadephia's for Coronet, which I thought very good.

But plenty of listeners could prefer it.

The playing is flexible enough, but it is also straight-forward, with no obvious appeals to the gallery. It has good weight and a balance which is most satisfying.

I must mention particularly the quiet surface. Unless you listen closely I doubt whether you will hear it at all, and in my book that is a great asset.

Incidentally, the selections are all banded, and can thus be picked out at will.

There is a suggestion of pre-echo once or twice, and one band on side comes in slightly low in pitch, which I found annoying.

★ ★ ★

MAILLART — Das Glockchen des Eremiten, Er Liebt Mich; AUBER — Fra Diavolo, Erblickt auf Felsenholn, Nur unbesorgt. Sung by Rita Streich with the Radio Symphony Orchestra, Berlin. DGG 30 299 EPL.

Very good recording indeed of a distinguished and natural singer quite at home with what she is doing.

Once again this month I must compliment DGG on the quality of a vocal disc which has some quite thrilling sound.

★ ★ ★

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The Pilgrim's Chorus I liked best. In the others the balance isn't always as good as it might be.

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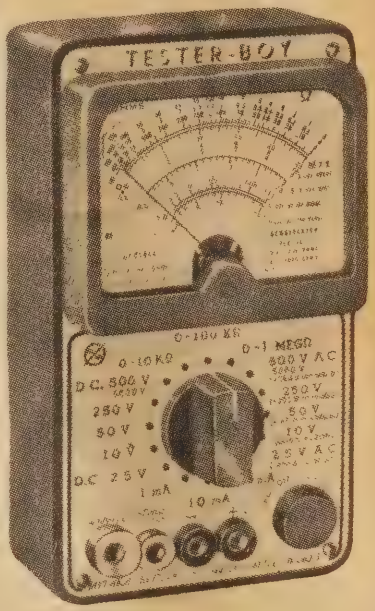

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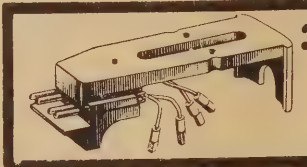

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BARTOK — Divertimento for String Orchestra. WEINER — Suite Opus 18, Hungarian Folk Dances. Played by the Philharmonica Hungarica conducted by Antal Dorati. Fontana 698 004 CL.

There is probably some interest value grouping two Hungarians together on ne disc, but as far as the music goes is is an academic interest only.

Weiner is the only real Hungarian of e two, if we think of folk tunes and inces as being typical of the country, no doubt they are.

But Bartok is a very different proposi-on — he is not essentially a nationalist all, but an individualist and an inter-ational.

You could never mistake a bar of him or one written by Weiner. There is othing intellectual about Weiner — ist entertaining and often brilliant ar-ngements.

As compared with Bartok the orches-ation is conventional in the extreme nd just as competent. Weiner, it will e remembered, was a prolific arranger, is Bach transcriptions for orchestra be-g famous.

It's not surprising therefore to find right and satisfying music on this side.

The title of the Bartok Divertimento oesn't tell us a thing about the work hich is expanded to symphonic pro-ortions. And yet it is not a symphony, ot even in spirit; rather is it an imagina-ve progression of ideas worked out with ghtning changes of mood and wit.

Bartok is not a hard composer to nderstand, although his idiom is be-ildering to the newcomer and not al-ays immediately obvious. The quality f his work is apparent even before it is nderstood. There are contemporary ainters whose pictures immediately at-ract the eye as being different from the naze and mess that often passes for rt. Similarly, no matter how much un-ntelligible sound one has heard pro-uced by extremists and moderns, and ecoiled therefrom in bewilderment, it is mpossible not to recognise the differ-nce in even the smallest composition f Bartok.

This work has been recorded several mes, and although I haven't any others or comparision, I was impressed by the itality and certainty with which it is layed here. I don't know that a Hun-arian orchestra should play Bartok bet-er than anyone else, but I at least didn't nd it at a loss.

It is even better in the Weiner where s local character would at least issue challenge to do well.

The recording is lively and balanced. I ked the brass and its sound — the pening sections of the Weiner are a ood example. And the surface is of top uality.

Fontana should be proud of this one.

★ ★ ★

MENDELSSOHN — Symphony No. 4 in A Opus 90 (Italian); Symphony No. 5 in D Minor Opus 107 (Reformation). Played by the N.B.C. Symphony Orchestra conducted by Arturo Toscanini. RCA L16019.

In the Italian symphony, Mendelssohn xpresses his reactions to his first visit o Italy, and these were happy and ivid.

No one could fail to respond to it in he same mood. The first movement lunges into a burst of sunshine and excitement, magically heightened by the composers' favourite trick of using staccato horns. "Plunge" is the word, and unless both conductor and orchestra understand the significance of it they may as well pack up and go home.

Fortunately most of them do, but none of them as well as Toscanini. Spurred under his urgency, and made possible by its own superlative technique, the orchestra leaps into life with an irresistible sense of drive and movement.

No other recording does it as well.

Both sides were made from an actual broadcast recording at Carnegie Hall some years ago, so don't expect the sound to measure up to the superlative effects we get from studios these days. The wheel seems to have turned back to the concert hall approach in the most recent times, but with better balance than this.

There isn't much reverberation, although considerably more than in Toscanini's horrible studio efforts, and the bass and tympani, in particular, are rather dead and slight of stature.

And while the symphony in the main gains greatly from the conductor's lively gait, the last movement is over-eager. But with the tempo and attitude with which the symphony began, it could not possibly have ended on a less boisterous note.

I think there is so much of Toscanini in it, and so many things which only an orchestra of this quality could have achieved, that I willingly accept some recording limitations to hear it, for it will always sound fresh and exciting.

Of the Reformation Symphony I can't be so complimentary, mainly because, apart from a few typically musical passages, I can't place it in the same class as a work.

But that's only an opinion, and you mightn't agree.

The record seems to be quite well cut, and the surface if not first rate at least satisfactory.

★ ★ ★

SCHUBERT—Fourth Movement of Trout Quintet. HAYDN—Second Movement of Emperor Quartet. Played by the Koekert Quartet with Adrian Aeschbacher, piano. DGG 30061 EPL.

Rather a novelty this, to present movements from chamber music as separate items.

I can only hope that those who buy this disc will be led by it to listen more to complete works, for I have never been able to understand why they are so far down on the popularity lists.

Very few recording companies view the release of quartets and the like with much enthusiasm.

And yet some of the finest music ever written, and probably the most profound is in this form.

Haydn's lovely slow movement from the Emperor will come as a shock to many who have never associated it with a string quartet. The Koekert play it smoothly and with very fine control; the recording is equally smooth, clear and distinct.

You could easily copy out the parts from it should you be so inclined.

The Trout melody will be almost as well known, and it is so good that Schubert used it more than once.

There could scarcely be a greater

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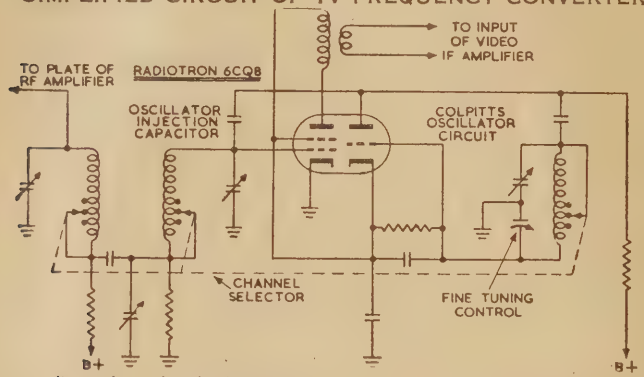
The desirable requirements for TV frequency converters and if amplifiers can be summarised as follows:—

(a) transconductance should be high to provide as much gain as possible in the low-impedance, wide-band circuits used in a TV receiver.
(b) the equivalent noise resistance should be low for good signal to noise ratio in the frequency converter stage.
(c) there should be little feed-through from the oscillator to the rf stage to keep the oscillator radiation to a minimum.
(d) the oscillator section of the converter should have good frequency stability, and possess characteristics which make oscillation of the right amplitude easy to obtain.
(e) the application of a variable control voltage to the grid should not have any appreciable effect on the input impedance to the valve when used as an if amplifier.

SIMPLIFIED CIRCUIT OF TV FREQUENCY CONVERTER



Theory predicts that the higher the transconductance (g_m) and the sharper the cutoff characteristic in the mixer section of a converter, the higher will be the conversion transconductance (g_c). The lower the bias required for plate current cutoff, the smaller the oscillator injection voltage that is required for maximum g_c and hence the lower is the oscillation radiation. Multigrid types of converters, i.e. those in which the signal and oscillator voltages are applied to separate grids, can be shown to be noisier and to have lower g_c at high frequencies than the types in which both voltages are applied to the one grid.

For the oscillator the most satisfactory operation is obtained by using a triode of high g_m and medium amplification factor (μ) in a circuit which will provide good frequency stability. The Colpitts type is often used for this purpose.

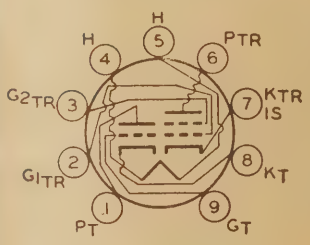
The series connection of the oscillator and mixer sections of the converter across the B+ supply offers the advantages of a reduction in current drain and more constant oscillator injection over the frequency range, due to the current-stabilising effect of this type of connection.

To maintain a desired relationship between transconductance and input impedance for valves used in the gain controlled stages of if amplifiers an unbypassed cathode resistor is commonly used; the use in if amplifiers of valves with internally-connected suppressors then presents difficulties in obtaining satisfactory stability. Valves featuring a tetrode construction avoid this complication.

The Radiotron 6CQ8, which has been especially designed to meet the requirements mentioned above, features a plate current characteristic with a sharp knee at relatively low plate voltages and mixer operation with good linearity in the frequency converter stage in the TV receiver. The tetrode construction of the 6CQ8 avoids the difficulties in stability outlined above, and together with the other characteristics of this valve, allows high performance to be obtained as a TV if amplifier. The tetrode section is also suitable for use as a sound if amplifier and agc amplifier. The triode is suitable for use as a sync. separator and af amplifier, and as an af output stage where only moderate output is required. The triode may also be used as a cathode follower driven by the tetrode section in the video amplifier stage.

6CQ8

SOCKET CONNECTION
Bottom View



PIN 1: TRIODE PLATE
PIN 2: TETRODE GRID No.1
PIN 3: TETRODE GRID No.2
PIN 4: HEATER
PIN 5: HEATER
PIN 6: TETRODE PLATE
PIN 7: TETRODE CATHODE, INTERNAL SHIELD
PIN 8: TRIODE CATHODE
PIN 9: TRIODE GRID

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contrast with the Haydn in both mood and treatment, which is all to the good.

Both performances are first-rate, and, no doubt, they are taken from previous issues. The recording, too, is of high standard. I rather liked the slightly back-stage atmosphere of the pianist and his deft handling of the "Trout" atmosphere.

The surface and engineering generally are both good.

★ ★ ★

GRIEG.—Piano Concerto in A Minor Opus 16. Played by the Berlin Symphony Orchestra conducted by Leopold Ludwig. WGG LPE 17143.

The virtues of this record I thought were uneven.

It is warm, romantic music, and it's no use trying to make it anything else.

I have heard it played simply and artlessly, I have heard it built up to considerable size, and if well done it sounds good either way.

But it does not sound as good when subjected to violent changes of tempo, or made the subject of hard-driven technical displays, both of which are calculated to drive the spirit out of it.

My objections are the more definite when all these approaches are mixed together, to the extreme detriment of consistency and style.

It sounds just as though both pianist and conductor had got together to see if they could pep up the old warhorse or even as though they haven't realised just what makes him tick.

If such eccentricities are permissible, then there is much to admire in this recording, which I thought well-balanced, clean and most competently played.

The piano is very much to the fore and quite capable of overpowering the orchestra if required. Its tone is good, although a little bit tubby at times.

Dynamic range is high and also cutting amplitude. But you must be prepared for a different brand of Grieg.

★ ★ ★

VIENNA.—Morning Papers, Emperor Waltz, On the Beautiful Danube, Invitation to the Dance, Village Swallows, Waltzes from Rosenkavalier. Played by the Chicago Symphony Orchestra conducted by Fritz Reiner. RCA L16088.

Strauss waltzes have all the elements to make them immortal. Musically, they have melody, rhythm, fascination and charm.

Emotionally they have a free and uninhibited range of joy, sadness, romance and nostalgia, all of which must grow in effectiveness with the years.

Like all really great music, they have an appeal which is completely universal, and, when well played, completely irresistable.

It is conventional and fashionable to praise them, but no music more deserves its indestructible popularity.

Records have done a great deal to perpetuate this popularity, for the waltzes are well suited to the richness and weight of a modern orchestra, so filled with brilliant and subtle scoring that we actually hear more of them than we would in a concert hall.

I have never heard an American orchestra play them more successfully and very few which have done as well.

Reiner has tempered the sharp discipline of the players which might easily have pared away the essence of the music.

He has been careful not to use it as material for a demonstration disc. Even the Invitation to the Waltz (by Weber), which has been glamourised to the limit in the past, has escaped this fate.

As a recording it is concert hall in atmosphere with a pronounced reverberation which suits it very well. The sound has good body, and the bass adequate if restrained.

Cutting amplitude is moderately high and surface noise noticeable but not by any means bad.

In general, it is an attractive musical disc which I thoroughly enjoyed.

★ ★ ★

DVORAK. — Cello Concerto in B Minor, Opus 104. TCHAIKOVSKY — Variations on a Rococco Theme, Opus 33. Played by Gaspar Cassado and the Pro Musica Orchestra of Vienna, conducted by Jonel Perlea. Vox APL9360.

Not much has been heard of Cassado for some time, at least out here, and it was rather a surprise to find him appearing for Vox.

In playing the Dvorak Concerto, he is taking issue with some extremely fine cellists, which include Janigro, Tortellier and Fournier.

Not that he need worry unduly, for he has long been among the finest living performers, and still is, despite his more than 60 years.

The concerto is, I think, one of Dvorak's loveliest works, and the most frequently recorded of major cello compositions.

As I have frequently pointed out, the cello owes a great deal to the recording process, for it does not sound so clearly or so powerfully in a concert hall.

On this disc it is particularly forward, and its vitality in some "close-ups" is tremendously thrilling.

We rarely hear a bow bite the strings with such power and pressure.

There are two cellos in our house, and that's the way they sound — or should — in real life.

Frankly I doubt whether it was really necessary to use such close miking. Bow noises are not always pleasant, and slight flaws in intonation, which all but a few cellists are guilty of from time to time, are starkly exposed. To be honest, there are a few more on this disc than there should be.

On the other hand, I wouldn't willingly lose anything of the playing heard in the last movement, for instance, where Cassado displays great virtuosity.

Both he and the orchestra treat the music in the grand manner, reaching deeply into its strength and poetry, quite equal to its heavy demands.

The closeness of the cello is accentuated by the noticeable reverberation on the orchestra, but this is inevitable with such technique and is found on nearly all such records.

The orchestra's tone has a slight edge to it, and it sounds best with the E.M.I. curve or some top cut.

A first-rate performance, ranked at least in the first three.

Vox always has an eye for value, and the addition of the Tchaikovsky's maintains this tradition.

Here Cassado produces some splendid playing, and his extra appearance adds greatly to the disc's appeal to your pocket.

Mostly the surface noise is quite low

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SHORT-WAVE NOTES BY ART CUSHEN

KGEI SAN FRANCISCO RETURNS

The reappearance for the old KGEI transmissions in the 16 metre band will be welcomed by old friends of this station.

THE familiar signals of KGEI which have been in service since 1939 are again on the air after a period of two years of inactivity. The station was firstly at the San Francisco Exposition on Treasure Island, using the call sign W6XBE. Later the station became KGEI with broadcasts of the United States Information Service and under the ownership of the General Electric Company. The station was reopened for transmissions to South America, using the slogan, the "Voice of Friendship." The station uses the frequency of 17800 Kc, and is on the air from 11.30 a.m to 2.15 p.m. Programmes in Portuguese, Spanish and English are released, the latter language at 1.15 p.m.

The broadcasts from KGEI are well received on 17800 Kc, and the signal is free from interference throughout the broadcast. On Sundays a programme in English from 1.15 p.m. includes a mailbag session at 1.40 p.m., during which letters from listeners are answered. The station asks for reports to P.O. Box 15, San Francisco. KGEI closes with the "Lord's Prayer" and the Star Spangled Banner at 2.18 p.m. The station states its broadcasts are dedicated to peace and friendship in the Americas.

Iranian Regional Station

THE broadcasts from Radio Teheran are comparatively well received in this area, but the recent announcement of regional transmitters in this country will give listeners further signals to look for. The stations, which are listed in the session from Radio Australia, are operating on the following frequencies and schedules.

SENENEDAY 6705 Kc, 9.30 p.m to 11.30 p.m. and 1.30 to 3.15 a.m.

AHWAZ on 7990 Kc, 10.00 p.m. to midnight.

ISFAHAN on 6175 Kc operates 11.30 p.m. to 2.30 a.m.

MESHED on 6870 Kc operates 9.30 p.m. to 1.00 a.m.

MAHABAD using also 6870 Kc operates on a schedule which is not known

REFHT on 7940 Kc is on the air 10.30 p.m. to 12.30 a.m.

SHIRAZ on 6383 Kc broadcasts 11.00 p.m. to 2.00 a.m.

National Education Radio

AIRMAIL verification has been received in response to our report on the reception of the Thailand station operated by the Department of Education. The letter from the Ministry of Education in Bangkok was from Mrs Ambhorn Meesook, Secretary to the Executive Committee of the Education Broadcasting Service. The Ministry operates the stations on 6062 and 3205 Kc and both use 2.000 watts. The stations are also in chain with a medium wave transmitter of the same power. The 6062 Kc station normally tests at 8.30 p.m. and sign on is at 9 p.m., which is equivalent to 6 p.m. in Bangkok.

Broadcasts from Haiti

THE Evangelistic Voice of the West Indies, which is broadcasting from Cap Haitian, has made further changes in frequencies to those we announced last issue.

The transmissions are now broadcast as follows

4VWI (11850), 4VE (6100), 4VEH (9770), 7.30 p.m. to 9.00 p.m., and on Sundays 7.15 p.m to 10.00 p.m. English is broadcast from 8.00 to 10.00 p.m. 11.00 p.m. to 1.00 a.m. with English on Mondays.

4VWI (9635), 4VE (6100), 4VEH (9770), 3.00 to 4.00 a.m. and on Monday from 4.00 to 6.00 a.m. English is carried on Monday.

4VWI (17770), 4VE (6100), 4VEH (9770), 8.15 a.m. to 2.00 p.m., with the English period 11.00 a.m. to 1.15 p.m.

The frequency of 9770 is moved to 9760 Kc, from 1.15 p.m. to 2.00 p.m. to avoid interference from B.B.C. on 9770 Kc. The 4VWI on 9635 Kc on Monday uses 21525 Kc.

Regular Broadcasts from Rangoon

AFTER several months of experimental broadcasting in the 13, 16, 19 and 25-metre band the Burma Broadcasting Service has commenced regular transmissions on lower frequencies. The Rangoon stations have also been allotted call signs and these are in the same prefix group as in prewar days when the Rangoon stations used the call signs XYZ and XZZ. The station now uses the power of 50.000 watts on all frequencies.

4795 Kc XZK2, 10.00 a.m. to 2.00 p.m., 8.00 p.m. to 3.00 a.m.

6035 XZK3, 10.00 a.m. to 8.00 p.m.

7125 XZK4, 10.00 a.m. to 2.00 p.m. and 8.00 p.m. to 3.00 a.m.

9540 Kc XZK5, 3.00 p.m. to 8.00 p.m.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

Brazilian on 17875Kc

SIGNALS from Rio de Janeiro have been heard in the afternoons on 1785 Kc, to close down at 2.00 p.m. This broadcast originates from the Ministry of Education station PRL2, and is heard also on the PRL4 transmitter on 9770 Kc. The latter station suffers severe interference from the B.B.C., London, on the same frequency. The signals on 17875 Kc are fairly strong and the programme is normally of classical music with frequent announcements in Portuguese. The station signs off with the Brazilian National Anthem, but on some occasions has left the air with the usual station identification followed by a four-note chime. Broadcasts from this Education station have been heard in recent years on 11955 Kc, but this is the first time such a high frequency has been noted from the Rio station.

Prague Signals Improve

THE reception of the Prague transmissions are reported by Mr A. Lee, of Merewether, Newcastle, who was one of the listeners who recommended the start of the transmission in 1957. This service from Prague to Australia is from 6.30 to 7.30 p.m. daily. Signals in the summer are received well, but the service has little value in winter. The signals at present are on 11720, 15180 and 21450 Kc. The station has appreciated the reports by the sending of books, silk bookmarks, verification cards and many other souvenirs.

BROADCASTS FOR CHATHAM ISLANDS

Broadcasts of a daily news service for the settlers in the Chatham Islands are now being carried on a daily basis. The Islands, located to the east of New Zealand, are a dependency of the Dominion, and the station which carries the broadcast is normally used for local communication work The transmission is on station ZLC using 2196Kc and with the power of 50 watts. The broadcasts are from the chief settlement Waitangi and are on the air at 7.15 a.m. Chatham time is 12 hours 45 minutes ahead of GMT. This unusual time zone enables the island to be on the same date as is being observed in New Zealand. It would normally be 23 hours 15 minutes behind New Zealand time, which is 12 hours ahead of GMT. The programme is of news and information on aircraft and shipping for the information of the settlers.

FLASHES FROM EVERYWHERE

BRAZILIAN station Radio de Ministero de Agricultural, and located in Rio de Janeiro, has commenced experimental broadcasts. The station is using the frequency of 15105 Kc from 8.00 p.m. to 6.30 a.m. The station has been heard in Europe and possibilities of it being heard at 8.00 p.m. at the present time are very favourable.

MANILA station of the Peoples Broadcasting Service, is now announcing two shortwave frequencies only, 6170 and 11840 Kc. It would appear that the former frequencies of 9570 and 9615 Kc are not now in operation.

CAIRO of the United Arab Republic Radio is now on a more extensive schedule reports the World Radio Handbook. The main Arabic programme which is on the air from 2.15 p.m. to 9.00 a.m. is on 9790 Kc. From 2.15 to 5.00 p.m., 9.00 to 11.00 p.m. and 12.30 a.m. to 9.00 a.m. the transmission is also on 15390 Kc. Voice of Arabs programme which is also beamed to the Sudan, is on the air 1.30 to 2.20 p.m., 2.30 to 3.30 p.m., 9.00 to 10.00 p.m., 12.30 to 2.20 a.m. and from 2.30 to 8.30 a.m. on 7050 and 11670 Kc. 4.30 to 8.30 a.m. on 15330 Kc. Beamed to South East Asia from 9.00 p.m. to 1.00 a.m. on 17915 Kc with English broadcasts 11.30 p.m. to 12.30 a.m. Programmes to East Africa 3.15 to 5.30 a.m., 3.15 to 4.30 a.m. on 17915 Kc. Broadcast to Middle East, 1.15 to 2.45 a.m. and 3.00 to 3.45 a.m. on 11990 Kc. Service to Europe from 5.00 to 8.00 a.m. on 11990 Kc includes a program in English from 7.00 a.m. to 8.00 a.m. Cairo broadcasts to South America from 10.00 a.m. to 10.45 a.m. in Portugese and 10.45 a.m. to 11.30 a.m. in Spanish both carried on 9790 and 15390 Kc. Arabic programs to the Americans is on from 11.45 a.m. to 12.45 p.m. on 9690 and 15390 Kc.

AFGHANISTAN station Radio Kabul has made a frequency change to 6005 Kc, and should be able to be received much better in this area. The station is on from 10.30 p.m. to sign off at 4.00 a.m. Programs in Pushtu are on at 11.30 p.m. to 1.00 a.m. and 2.00 a.m. when news is carried English programs are from 2.40 to 3.00 a.m. and a news bulletin is released at 2.45 a.m. The news in Persian is carried at 3.00 a.m.

YUGOSLAVIA RADIO operates some 19 stations on medium wave, four on short wave, 11 on frequency modulation and five television stations. The short-wave transmitters use 100 kw on 6100 and 6150 Kc and are 10 kw on the other channels. English at 11.30 p.m. to midnight is on 6100, 9505 and 15240 Kc. In English also from 5.30 to 6.00 a.m. on 6100 and 7200 Kc.

TANGANYIKA Broadcasting Corporation, which has transmissions from Dares Salam, has the postal address as Box 1649. The station on 5050 Kc with 20 kw, operates 1.14-2.15 p.m. in Swahili and from 2.15 to 3.00 p.m. in English. Daily transmissions are from 11.30 p.m. to 4.00 a.m. in Swahili, and then from 4.00 a.m. to sign off at 5.30 a.m. the program is in English. On Sundays the transmission is carried to 6.00 a.m. in English. A further frequency of 7167 Kc, with 5 kw, is a service for educational broadcasts from 6.00 to 7.00 p.m., in English and daily from 7.00 to 9.15 p.m. in English.

SOFIA now has a session of DX news from this Bulgarian station, and this is released on the first Friday of each month. English is broadcast at 5.30 a.m. on 7255 and 7670 Kc. A further session at 7.30 a.m. is carried on the additional frequency of 6070 Kc.

S.A.B.C. transmissions from Johannesburg have been noted on a new frequency, and now broadcast on 15205 Kc, replacing 15230 Kc. The station has been heard after 2.00 a.m. with little interference with English news at 3.00 a.m on Wednesday, Friday and Sunday mornings; on the other days the broadcasts are in Afrikaans.

HONGKONG is at present being well received on the frequency of 3945 Kc with a broadcast in Chinese. Radio Hongkong is best received in the last 30 minutes of the transmission to sign off at 2.00 a.m. as, during this period, interference is light. The main deterrent to clear signals is the Indonesian station on 3940 Kc which is heard to 1.30 a.m.

TEHERAN, with broadcasts on the new frequency of 15120 Kc (formerly on 15100 Kc) has been noted with English news at 6.30 a.m. An English listener states that the station announces the frequency as 15100 Kc and that also broadcasts are carried on 9680 Kc and medium-wave frequency of 1250 Kc.

MANILA station of the Far East Broadcasting Company, which we reported as testing on 11920 Kc, is now using the frequency for regular transmissions. We have been hearing this transmission as early as 11 p.m. and to 2 a.m. at which time it is covered by interference. The station has been assigned the call sign DZ15, and the other frequency 153[illegible] Kc has been assigned to DZ19.

AMATEUR BANDS WITH BILL MOORE

Australian Radio Amateur representation at the International Telecommunications conference to be held this year at Geneva should prove invaluable. It will provide an insight into conferences at this level and have a marked effect on the pattern of future WIA negotiations on matters affecting the movement.

THE first news of the appointment of the Wireless Institute of Australia's delegate to attend the I.T.U. Conference at Geneva this year was carried over the A.B.C. news service on Saturday, November 29.

The delegate will be John Moyle, VK2JU, Past President, Federal Councillor and Life Member of the N.S.W. Division, well versed in all aspects of amateur radio, technically and politically.

Under arrangements with the Federal Government the W.I.A. delegate will be an accredited member of the Australian Delegation and will attend as an observer.

The appointment is the most important and exacting ever given to any amateur by the Wireless Institute of Australia.

John was introduced over VK2WI on Sunday, November 30, during the normal broadcast and he spoke of the problems, aims and objects of such representation. During the call-backs amateurs congratulated him on his appointment.

The task ahead of John is a difficult one—many of the decisions on the nation's intentions in variations in frequency allocations, etc., will be decided before the delegation leaves. In fact, these proposals from all nations were due in Geneva in mid-December. The value to the movement and the W.I.A. of such attendance will be in experience and information gained at such an international level.

Contacts will be made with similar delegates and the exchange of information on amateur radio problems will be of considerable importance.

The opportunity will undoubtedly arise on many occasions when the amateur's viewpoint can be brought forward and his interests guarded.

The fund for the financing of the expenses of the delegate conducted by the Federal Executive of the W.I.A. is approaching £2.000 and the target of £2,500 should be reached next year.

It is important that sufficient funds should be made available and contributions should be forwarded to the Federal Secretary, W.I.A., Box 2611W, G.P.O., Melbourne.

The Federal President of the W.I.A., Max Hull, VK3ZS, is preparing a complete report on the negotiations that were carried out prior to the acceptance of the W.I.A.'s delegate as an accredited member of the I.T.U. delegation. The Federal Executive have performed valuable work in the conducting of the I.T.U. Fund and the necessary liaison connected with the proposition.

Field Day

IT is just 25 years since the first field day was held in the Lakes area, Wyong to Woy Woy. They have through the years provided an opportunity for Newcastle, Sydney and local amateurs to get together.

The November event was run in similar pattern, over 200 persons attending with 94 amateurs and associates registering. 22 registrations were from the Newcastle area.

Among the call signs listed were VK2ALA, 2RU, 2ALJ, 2ON, 2AVW, 2FJ, 2PI, 2BZ, 2CE, 2ZDC, 2ZAV, 2AWZ, 2ZCF, 2ZFC, 2RJ, 2AHA, 2ZDL, 2AEE, 2JR, 2PM, 2AQR, 2LZ, 2AFA, 2AGY, 2XT, 2APQ, 2ZDF, 2KS, 2ACT, 2OQ, 2AMU, 2AZE, 3ZEG, 2VU, 2KO, 2ANU, 2ANA, 2ASZ, 2ARG, 2QF, 2GE, 2WJ, 2AJY, 2ACD, 2EO, 2OA, 2HZ, 2AKR, 2ALA, 2YA, 2ZBG, 2CS, 2ND, 2OT, 2ABU, 2AOR, 2ZFL, 2VY, 2AIM, 2GA, 2PZ, 2LS, 2ZC, 2FP, 2TX, 2PW, 2VL, 2AT, 2SF, 2AAS, 2AWQ, 2DY and 2AKP.

The event is now conducted annually by the Gosford Radio Club, the Central Coast Section of the N.S.W. Division. The day's program was fully organised and the venue, the Gosford Sailing Club, is ideally situated beside the Olympic swimming pool.

The field events were particularly well supported with two 144 Mc hidden transmitter searches and two 7 Mc scrambles.

The "easy" morning 144 Mc search saw most parties on the wrong side of vast stretches of water.

It was only some of the dichards that ventured the long way round and the transmitting period was extended to permit the contestants to locate the transmitter in the mangroves. Dave Andrews, VK2AWZ, was the winner with John Lark, VK2ZAV, in second place.

The "difficult" hunt in the afternoon saw the parties gathered at grounds, the transmitter was fired up and the bearing suggested the signal came from across the water.

Tally ho, the fox!

The "flag" was dropped and most parties dashed to the other side of the bay.

The signal did come across the water but not for a great distance. The transmitter was located in the bow of George Shelley's, VK2QF, boat at the end of the jetty at the Sailing Club's grounds. Cec Cronin, old VHF enthusiast, did not venture far and won the event with Dick Graham, VK2ZBG, second. Quite a number of the later contestants were too polite to board the boat and investigate.

The 7 Mc scrambles varied, in the morning event mobile aerials only being permitted for use, in the afternoon any aerial. Harold Whyte, VK2AHA, was successful in the a.m. and L. Baber, VK2RJ, in the p.m. event.

Bill Bell, VK3ZFG, who travelled the greatest distance received a special prize and the quizzes were won by Mrs Agar and Dave Davies, VK2BZ.

As with all events of these types the work of a comparative few make the day a success.

The ladies catered for all at lunch and they were busy all day dispensing drinks and ice-creams to the children at various times. The helpers included Mrs 2RU, Mrs 2ALA, Mrs Brookes, Mrs Young and Mrs Jeff Morris. The menfolk were very active—Branch Secretary Reg Brookes and President Major Collett, VK2RU, were to the fore as were Perc Day, Registration, and Jack Ferguson, VK2FJ, Jeff Morris, Rex Black, VK2YA, Fred Adams, VK2ALA, Bill Marsh, VK2PI, and other members of the club.

Alex Dan, VK2ABU, conducted the usual disposal sale.

The field day will be on again in November—make it a date.

N.S.W. Convention

THE annual convention of the N.S.W. Division will be held at the institute's VK2WI grounds at Quarry Road, Dural. As usual it will be conducted over the Australia Day weekend, January 24, 25 and 26, 1959.

A comprehensive program is being arranged and a large marquee will be erected. To ensure that the anticipated crowd of 250 will be well covered if the weather is inclement. Lecturettes, films, etc., will be shown.

The event will commence with the January general meeting.

It will be held at Science House, Gloucester Street, Sydney, on Friday, January 23.

The Dural section on the Saturday will commence with registration at 2 p.m. The program covers afternoon and evening sessions. As well as the features mentioned there will be a disposals sale, display of home-built equipment, and the usual things that are arranged for these events.

A BUSY WEEKEND FOR AMATEURS

THE Australia Day weekend in January can be a busy one if amateurs operate in the contests conducted or for that matter in N.S.W. attend the State Convention.

On that weekend two contests are conducted annually, the RSGB's BERU event and the WIA's National Field Day.

The following are the main rules of both contests:—

BERU:

The contest is for CW only and divided into two sections, High Power (maximum licensed power) and Lower Power—maximum input of 25 watts.

The contest (both sections) will commence at 0001 GMT on Saturday January 24 and conclude at 2359 GMT on Sunday, January 25, 1959. The contest is open to all fully paid up members of the RSGB within the United Kingdom, to all British subjects outside the U.K. but within the British Commonwealth and British Mandated Territories. To members of British Forces of occupation.

Operation is restricted to the following bands 3.5, 7, 4, 21, and 28 mc/s. Frequent tone reports of T8 and less may lead to disqualification.

Entrants must operate within the terms of their licence.

Contacts may be made with any British Commonwealth station or DL2 call-sign except contacts within the entrant's own call area.

Contacts with unlicensed stations in places where licences are obtainable will not count.

Only one contact on each band with a specific station will count for points.

Each completed contact will score 5 points. In addition a bonus of 20 points will be claimed for the first contact with each Commonwealth call area (as listed) on each band. All U.K. stations count as one call area (G, GC, GD, etc.).

Serial numbers are as usual for DX contests and must be exchanged before points can be claimed.

A Receiving Contest is run simultaneously with the transmitting event.

The following call areas are recognised for the purposes of scoring in the BERU Contest: G, GC, GD, GI, GM, GW — as one call area, MP4 Bahrein, Muscat and Oman), MP4 (Trucial Oman), ZB1, VE2, VE3, VE4, VE5, VE6, VE7, VE8AL (Yukon Territory), VE8 M-Z (N.W. Territories), ZCO (Australian Antarctica), VKO (Heard Island), ZCO (MacQuarie Is.), VK1, VK2, VK3, VK4, ZC5, VK6, VK7, VK9 (Norfolk Is.), VK9 (Papua), ZC9 (New Guinea), VO, VP1, VP2 (Leeward Is.), VP2 (Windward Is.), VP3, VP4, VP5 (Jamaica), ZF5 (Cayman Is.), VP5 (Turks and Caicos Is.), VP6, VP7, VP8 (Falkland Is.), VP8 (Grahamsland), VP8 (Sandwich Is.), VP8 (South Georgia), VP8 (South Orkney Is.) VP8 (Sopth Shetland Is.), VP9, VQ1, VQ2, VQ3, VQ4, VQ5, VQ6, VQ8 (Chagos), VQ8 (Mauritius), VQ9, VR1 (Gilbert and Ellice Islands), VR1 (British Phoenix Is.), VR2, VR3, VR4, VR5, VR6, VS1, VS2, VS3, VS4, VS5, VS6, VS9 (Aden), VS9 (Maldive Is.), VU2, VU4, ZB1, ZB2, ZC2, ZC3, ZC4, ZC5, ZD1, ZD2, ZD3, ZD4, ZD5, ZD6, ZD7, ZD8, ZD9, ZE, ZK1, ZK2, ZL1, ZL2, ZL3, ZL4, ZM6, ZS1, ZS2, ZS3, ZS4, ZS5, ZS6, ZS7, ZS8, ZS9, AP, ST2, 4S7, and DL2.

Logs should be forwarded to Contests Committee, RSGB, New Ruskin House, 28-30 Little Russell Street, London, WC1, not later than March 31, 1959.

Amateurs trying to improve their country totals should look in on the BERU contest, some of the rarer British prefixes can be heard.

National Field Day:

The object of the day is for portable and mobile stations within VK to contact similar and fixed stations in any part of the Commonwealth (including own State).

Contest will be conducted between 0900 and 2100 hours EAST on January 25, 1959.

The contest shall be open and divided into the following sections:—

A. Single Operator: Transmitting.
1. Portable or Mobile HF.
2. Portable or Mobile VHF.
3. Fixed HF.
4. Fixed VHF.

B. Multiple Operator: Transmitting. Similar divisions to single operator.

C. Receiving.
1. Fixed or Portable HF and VHF.

Maximum power 25 watts input with power not derived from private or public mains.

Portable or Mobile stations must be located further than one mile from home QTH of operators.

No apparatus must be set up prior to 24 hours before starting of contest.

More than one transmitter may be used and simultaneous operation of them on several bands is permitted.

Cross-band operation is not permitted.

The usual serial numbers must be exchanged before points are scored.

Call areas constitute VK1 and VK2 combined, VK3, VK4, VK5 (South Australia), VK5 (Northern Territory), VK6, VK7, VK9.

Scoring is on a sliding scale and log entries should be forwarded to the Federal Contest Committee, WIA, Box 1234K, G.P.O., Adelaide, South Australia, postmarked not later than February 14, 1959.

Certificate will be issued to the highest scorer in each State in each section, if the scoring is considered adequate.

National Field Days here in Australia are being better supported each year and the Australia Day weekend should see increasing activity especially in the mobile field.

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Sunday will see VK2WI on the air on schedule and visitors are invited out to see the division's station in action.

The station site is ideal for country visitors to camp in or use as a caravan park. The marquee will be erected early so that it may be used for sleeping in.

Last year saw over 200 members and visitors present. It is the division's major event of the year—plenty of entertainment, prizes, etc. Catering has been arranged for the evening meal.

Contest Notes

WESTERN AUSTRALIA had a narrow win from Tasmania in the 1958 Remembrance Day contest and holds the trophy for another year. Again the smaller States fill the major positions.

The first R.D. contest was won by N.S.W. before the current system of adjusting final scores according to degree of activity in any State. Since this latter arrangement has been in force N.S.W. or Victoria have little chance of even appearing among the place getters.

It seems incredible that in the past contest Victoria, with an average of 925.5 points for the six leading stations including Ray Naughton, VK3TN, record score of 1,271 points could only run fourth in the contest.

Even more ridiculous is the position of the South Australian division's entry whose six leading stations averaged 1,004.5 points and only ran third.

The average of the six leading stations in Western Australia was only 795.7 points and in Tasmania 668 points.

The Federal contest committee has been working on an equitable scoring system and some adjustments have been made, but radical changes will be necessary before the larger States have a chance.

Percentage activity among the leading States runs around 40 per cent. Take a hypothetical case of similar activity in either N.S.W. or Victoria. Approximately 500 stations would be active and 300 would be operating in either Melbourne or Sydney. Imagine trying to find a signal on 3.5 or 7 Mc if only 100 stations were active at one time in the capitals.

Even if it was possible to obtain the necessary number of stations operating in the large States one would not be able to pass a serial number on the lower frequency bands.

If the six leading stations in any State put up the best performance surely they should receive credit for their work in the way of really useful contribution to their division's position in the R.D. contest.

On the original scoring basis South Australia would have run out winner of the 1958 event with Victoria second and N.S.W. third.

Perhaps some adjustment might have to be made to the sliding scale of points now in force or adjustments for State-wide activity allowances were dropped. To allow this latter factor to decide the ultimate destination of the coveted R.D. trophy is not reasonable or fair to the contestants who work so hard for their division and amass scores over the 1,000 point mark.

Openings on 50 mc

SOME excellent conditions were experienced on the 50 Mc band during November with openings for DX to JA. One of the best of these occurred on November 18. In the evening from 6 p.m. sporadic E provided signals from VK3, 4 and 5 and at 9.30 p.m. JA's appeared and stopped in until 11.15 p.m. Including the JA's some 35 different stations were heard in Sydney. The opening appeared to extend well south as JA's were heard calling VK7's.

A number of other sporadic E openings occurred during the month with varying States appearing. SWL Norm Burton recorded the opening of the eighteenth on tape, an interesting reminder of the DX that appeared. Vern Kerr, VK4LK, in Charters Towers with other VK's, has more or less a monopoly of VK/JA working JA's but just on months from the end of August have appeared daily at Vern's QTH.

According to reports there are just on 3,000 VK's working on 50 Mc and the band is really fill on good openings in the north.

The Ross A. Hull Memorial contest during December and January will see the band well populated and further opportunities of DX working.

The extension of the use of the band 50 to 54 Mc granted until December 31, 1959, will encourage future activity and the gathering of propagation data for the I.G.Y. project.

A request for the extension was made to the W.M.G.'s Department by the Federal Executive of the W.I.A.

Overseas 50 Mc operation is restricted to some degree by lack of DX openings. If the band follows last year's pattern February should see the world-wide contacts. However some excellent contacts have been reported and G4LX and ZE1JZ have QSO'ed the first recorded between England and southern Africa.

VE7AQQ reported hearing VK4XJ and VK3ZER in November, the first trans-Pacific reception since early in the year.

Transequatorial scatter is still regularly accounted for North and South American contacts.

A new certificate now being awarded is especially for 50 Mc operation. It could not be won here in Australia but indicates how the VHF gang operate mainly on the low end of their frequency bands even in the U.S.

The 51.30 club, 17 Massachusetts use that frequency exclusively. To encourage more tuning on the 50 Mc band the club will present a certificate to anyone who works 10 or more of their members while using a frequency of 51 Mc or higher.

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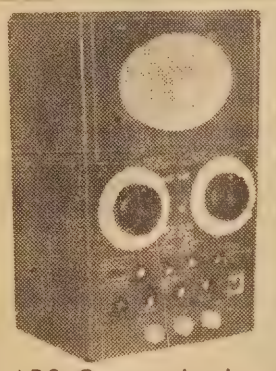

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Dual wave Tuner with R.F. stage Bass and Treble boost. 2 Jensen 12in speakers. 8 watts. O.P.

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TRANSISTOR 6 PORTABLE

R. T.V. and H., August.

Complete set of parts including plastic-covered cabinet and circuit.

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Wired and Tested,

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TRANSISTOR SETS

TRANSISTOR 7 PORTABLE

The extra I.F. stage trebles the range, doubles the selectivity. Ideal for country use.

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TRANSIGRAM

Complete kit, including Oval-tone speaker, 4-speed B.S.R. motor and pick-up and plastic-covered cabinet.

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TRANSISTOR PORTABLE RADIOGRAM

Complete 6 transistor kit with plastic-covered cabinet and B.S.R. 4-speed player.

£42/-/-

Wired and Tested **£45/-/-**

7 transistor set as above, **£45**

Wired **£48**

R. TV & H. 58 21in

The complete kit

£118

Wired and Tested

£140

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Fully Veneered Cabinet To Suit Q plus R. T.V. and H. and Ace. 17in Chassis. Not Polished.

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A complete range from

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Q plus KITS

17in **£119**

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Complete kit, including picture tube.

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ACE TV KIT SETS

Complete with all valves, picture tube and construction manual.

14in **101/-**

17in **105/-**

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6 Valve, 10 watt, **£14/17/6**

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BATTERY—AC OPERATION

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Steanes, Philips, AWA Mullard, Astor

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90 degree

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17" **£24/-/-**

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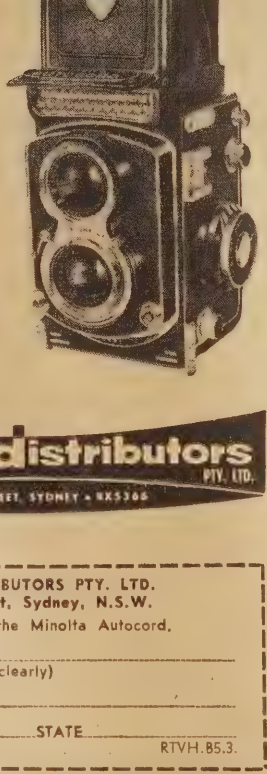
I.F. STRIPS

Complete with Valves Aligned & Tested

Your pick from Steanes R.C.S., Mahood coils

from £12/10/-

MINOLTA AUTOCORD



MINOLTA AUTOCORD. The Autocord to-day is a recognised world standard of quality and performance. Bought and preferred by professionals and amateurs who demand the best that money can buy. f:3.5/75 4-element lens, 1-1/500 sec. Seikosha MX shutter.

Complete, PRICE: £65/10/-

MINOLTA AUTOCORD 'L.' Same exceptional quality features as the Autocord . . plus built-in L.V. Exposure Meter that correlates with a simple light-value scale. A complete line of accessories is available for both Autocord Cameras: Autopole, Panorama Head, Paradjuster, Lens Hood, Filters, B.C Flash Unit, Self-Timer, Close-up Lenses.

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ADDING AUDIO STAGE TO TRANSISTOR SET

(Continued from page 43)

the set takes about 0.5 mA overall and with the circuit for low-impedance phones, you can expect the drain to be about 2 mA. In either case, the smallest battery you can buy will have a very long life.

At the same time it is worth noting that some of the smaller 9-volt batteries are almost as expensive as the larger ones: in other words you get better value for your money by buying a medium to large size battery.

Although a 9-volt battery complete with socket is very convenient, you can always make up a battery by soldering together individual dry cells. The set will work quite efficiently on any supply between 4.5 and 9 volts.

There will be individual readers who will wish to try a speaker. Let us say right from the start that the set was not designed to operate a speaker and that the best you can expect is to be able to hear the stations weakly if you put your ear close to the cone. Even this will apply only when you live close to the station.

NOT FOR SPEAKER

A further audio stage using perhaps a larger transistor would permit low, but useful, volume from a speaker under quiet conditions. For full portable volume a push-pull class-B stage using larger transistors would be the best solution.

Supplies of transistors have improved greatly over the past 12 months and there are a number of types from which you can choose a transistor for the output stage. Types OC71, OC66 and TS2 will all give about the same performance. The OC70, OC65 and TS1 will give slightly less gain but at the same time a very much worthwhile improvement in performance over the detector alone. The TS3 may give even more amplification than the OC71 or TS2.

As with the original single-stage receiver, the layout of parts is not at all critical. Make sure that all solder joints are well made and that no components are overheated during the soldering process. We suggest leaving the transistor leads full length so that it can be used in other circuits later without damage to the transistor proper.

It is a good idea to hold a pair of long nose pliers between the solder joint and the transistor to absorb some of the heat while soldering. The same idea can be extended to other components with beneficial results.

We hope that you will have lots of fun with this new little set and the others which we are planning for the next few months.

Making Fresh Water From The Sea

(Continued from Page 17)

rtments one millimetre thick of which e membranes comprise the walls.

When salt water is applied in a suitle manner to the unit the membranes lect the sodium particle or chlorine rticle respectively and allows them to ss through into the next compartment. This leaves fresh water in one comrtment and concentrated salt water in e next. Thus there are 150 compartents containing fresh water and 150 mpartments containing concentrated t water.

Each type of water is collected sepately and the unit will treat about 20 llons per minute producing about 70 r cent of fresh water and 30 per cent salt water.

While this method is quite effective converting sea water into fresh water efficiency increases with the reduction salt content. Thus with merely ackish waters it holds great promise in d and drought stricken areas such as rts of Australia, the Middle East areas d other desert regions.

NDERGROUND WATER

In such places there are often large ervoirs of underground brackish water ich is almost but not quite fit for man and animal consumption. The e of the membrane process will make s water available.

The process is even now used in the yan Desert where it is supplying the eds of oil drilling operators. It is o supplying the entire domestic rerements of 100 American Air Force n on a lonely outpost in the Atlantic ean.

One of the outstanding examples of use of this method is in the Orange ee State of South Africa.

Here large quantities of brackish ter accumulate in the mines and for ny years the disposal of this water created a major problem.

The water is so brackish that it is less both for domestic use or irrigan. The water accumulates at the rate some 15-million gallons per day.

Dams have been constructed into which the water is piped and where it is allowed to evaporate in the intense heat.

However, most of the available land for dam building is fast being used up and the problem was becoming almost insoluble.

Now, with the construction of a huge membrane water treating plant it is estimated that up to three or four million gallons of water a day will be converted into fresh water which will be fit for human consumption and for irrigation purposes.

PORTABILITY

A big advantage of the electric membrane process is its portability. It can be fitted on to trailers together with a diesel electric generating plant and transported almost anywhere. The cost of maintenance is comparatively low and as more efficient membranes are developed the cost of production of fresh water from the sea is coming down to reasonable economic levels.

Some years ago the late Sir Frank Beaurepaire constructed a solar still at the Australian town of Mildura. With this he produced about eight gallons of fresh water per day for use in car batteries.

The simple solar still is one which can easily be constructed and can really be of great use in the "outback" for the conversion of brackish water from bores or springs.

It would appear then that the economic production of fresh water from the sea is well in sight. Tremendous amounts of money are being spent in all aspects of research and scientists all over the world are constructing experimental plants in the most arid regions.

I might wind up this dissertation with an apt phrase from the Bible which says, "The wilderness and the solitary place shall be glad for them and the desert shall rejoice and blossom as the rose."

We seem to be fast approaching the time when that prophecy will be fulfilled.

BIG BOEING COMES TO QANTAS

(Continued from Page 9)

perate essential services such as start ignition, lights, flare release, radio instruments.

Air conditioning and pressurisation are vided and sea level cabin pressurisa can be provided up to 22,500ft. The ximum pressure differential of 8.6lb sq. in can be provided at altitudes to 40,000ft.

ce elimination and defogging equipnt operates from the electric power em. De-icing blankets are provided the leading wing edges, the horizontal oliser and the vertical fin. Control in windows are defogged with the of an electrically conductive coating the glass.

The list of the electronic equipment ard the Boeing 707 reads like a catae from a major radio manufacturer. Comprehensive facilities for communication, navigation and automatic flight control are provided and much of the equipment is duplicated. The manual we saw shows 18 separate aerials only four of which are visible to the casual observer.

Atom bombs and freaks

JAPANESE and American doctors agree that the Hiroshima and Nagasaki atom-bombs did not create dwarfs or freaks and that so far there was no evidence that the bombs had affected the growth of children, either physically or mentally.

The doctors' observations were based on independent and joint scientific studies into one of the most widely feared effects of nuclear warfare today — the nightmare birth of a race of freaks.

SALE

JANUARY BARGAINS

FUSE HOLDERS
Bakelite panel mounting, front leading for standard 1¼" fuses 2/-

WINDING WIRE
24 gauge DCC copper, approx. ¼lb spools 3/-

MICA CONDENSERS
Moulded bakelite type in useful values. 12 assorted for 2/-

RESISTORS
1 Watt type BT1 and BW1 in 1 meg.; 0.05 meg.; 250; 175; 50 and 25 ohms. 12 assorted for 2/6

MICROPHONES
Miniature carbon inserts. See last R. & H. for full details 2/-

COAXIAL CONNECTORS
New small model, ideal for amplifiers, etc. Plug and Socket set only 2/-

POTENTIOMETERS
Standard size 50,000 ohms. with switch 3/6

RESISTORS
Heavy duty 300 ohm. 40 watt rating 2/-

TELEPHONE JACKS
Standard P.M.G. model single circuit 6d

PERFORATED ALUMINIUM
Finely perforated, ideal for air vents in instrument boxes, food cupboards, etc. Size 9in x 5in. Six sheets for .. 2/6

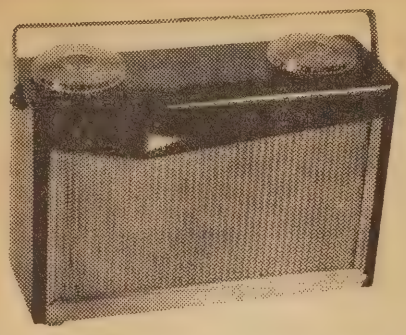
AMPLIFIER SPECIAL
Complete kit of parts for Mullard 3-3 amplifier, including valves and Ferguson transformers £16

Postage extra on all above goods

RADIO PRICE LIST NOW AVAILABLE

PRICE'S RADIO

5-6 ANGEL PLACE, SYDNEY



MAKING R. & H. TRANSISTOR PORTABLE ?

COMPLETE KIT OF PARTS

£26/10/-

POST EXTRA

SET WIRED AND TESTED £2 EXTRA

INCLUDING 6 S.T.C. TRANSISTORS, R.C.S COILKIT WITH PRINTED CIRCUITS, ROLA TRANSFORMERS AND 5F SPEAKER & ALL PARTS NECESSARY TO COMPLETE THIS SET INCLUDING ATTRACTIVE & DURABLE TWO-TONE PLASTIC COVERED CABINET WITH GOLD TRIM.

SPECIAL PURCHASE—HI-FI AT LOW COST

7-VALVE DUAL WAVE HI-FI CHASSIS WITH DUAL SPEAKERS AND LATEST COLLARO 4-SPEED RECORD CHANGER WITH CRYSTAL PICK-UP. THE TWO UNITS

THESE NEW 7-VALVE HI-FI CHASSIS USE THE LATEST PHILIPS 9 PIN VALVES INCLUDING THE DUAL-PURPOSE 6BM8 VALVES IN PUSH-PULL OUTPUT.

WITH EM80 "MAGIC EYE" TUNING INDICATOR, SEPARATE BASS AND TREBLE CONTROLS, ATTRACTIVE PLATEGLASS DIAL AND SUPPLIED WITH JENSEN M.S.P. DUAL SPEAKERS, 12in WOOFER AND 6in TWEETER. F.O.R. Packing 10/- extra. **£39/17/6**

NEW VALVES AT BARGAIN PRICES

EBC33 (interchangeable with 6B6G)	6/6	12K8	10/	6AC7	2/6	6F8G	10/6	ECH35 (interchangeable with 6J8G)	10/6
1C4	7/6	12SK7	7/6	6C8G	7/6	6A3	15/	7193	3/6
1D4	7/6	EK32	10/6	6SS7	8/6	7C7	3/6	954	2/6
1L4	4/6	6SA7GT	9/6	6H6	2/6	78	7/6	955	10/
1T4	10/	6SH7	5/6	6H6GT	1/6	EL32	10/6	12A6	10/
1S5	10/	1O5G	5/	6K7GT	7/9	15E	7/6	EF50	2/6
1S4	10/	1P5G	5/	6U7G	6/6	6V6GT	12/6	110TH	£2/9/
1R5	12/6	1C7G	5/	6J7G	5/	VR65A	2/6	811	£1
1A7GT	9/6	1K5G	2/6	6J6	5/	41	7/6	866-866A	15/
1D8GT	9/6							12SH7	5/
6A8G	10/6							6K7G	4/6
6K8G	9/6							100TH	20/
6SJ7GT	9/6							1C6	7/6
6X5GT	10/								

Please add Postage on All Valves.
SPECIAL PRICES FOR QUANTITIES.

SPARK-PLUG SUPPRESSORS

Kit of 6 plug and distributor suppressors. 10/.

AMERICAN TYPE T.U. TUNING UNITS

These units, 2 vernier dials, 2 transmitter tuning gangs, Ceramic coils, switches, etc. 27/6. F.O.R.

CARBON RESISTORS

New carbon resistors, mixed values Well-known make

10/- per 100. Post Free.

NEW I.R.C. RESISTORS

I.R.C. carbon resistors, ½, 1 and 2 watt, in values 50 ohms. to 5 meg., including many popular sizes, 3T. 15T. 20T. 25T, 50T. 100T. 250T, 500T, etc.

(Standard resistor colour code supplied.)

100 for 25/-

(Plus 1/6 postage.)

TV I.F. STRIPS

Complete, wired and aligned, supplied with seven miniature valves.
Post extra.

£14/10/-

TURRET-TUNERS £15/-/-

I.F. TRANSFORMERS

Standard I.F. Transformers, square can (1 3/8) 455K.C. permatuned. 4/3.

(Plus Postage.)

New Micro-Ammeters

0-100 micro-amp. 3in flush mounting.

55/-

CONDENSER SPECIALS

Boxes of 100 new Ceramic mica paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1. Also 500 mfd/12v., 10 mfd/40v., 16 mfd/350v., electrolytics.

25/- per 100.

Post Extra: N.S.W., 2/6; Int., 3/6.

MICA CONDENSERS

Standard Mica Condensers, small current types .00003 to .005 including most wanted values.

20/- per 100. Postage 1/6.

New Power Transformers

60mA prim.: 240v with 230v tapping, Sec. 285 285 with 6.3v filament winding 60mA.

27/6

Plus Postage: N.S.W., 3/6; INT., 5/3.

New Midget Power Trans.

40mA Prim.: 250v Sec. 225 x 225 with 6.3 Fil. Winding. Upright or Flat Mounting. Siz 2in x 2½in.

25/-

2/6 Postage, N.S.W., Interstate, 4/6.

30mA 240v. Prim. 150 x 150v. Sec. with 6.3 Fil. Winding.

22/6 Postage, N.S.W., 2/6; Interstate, 3/6.

Please address all correspondence to 332 Parramatta Road, Stanmore, N.S.W.

METROPOLITAN RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398
640 KING STREET, ST. PETERS, N.S.W. PHONE LA6087

VALVE SPECIALS! 50,000 New Valves To Clear

12 for ..	20/-	1P5, 1Q5, 1L4, 1K5, 1C7, 6H6GT, VR65A, 7193, EF50, 954, 955.
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3 for	20/-	EK32/VR57, EL32, 6K8G, 6K7GT, 3S4, 1S5, 1R5, 6AG5.

Post & Packing 4/6 extra

ALL VALVES ARE NEW AND MOSTLY IN INDIVIDUAL CARTONS

FOR THAT C.R.O. or TV SET

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809	8/6
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NEW DYNAMIC MICROPHONES

Bakelite hand microphone with switch, 20/-. Post 2/6.

Used, but in good condition. 12/6. Post 2/6.

No. 3 CARBON HAND MICRO PHONE. New. 12/6. Post 2/6.

SPECIAL!

NEW HIGH-FIDELITY 4-SPEED RECORD CHANGERS TURN-OVER CRYSTAL PICK-UP SAPPHIRE NEEDLES

£11/15/-

f.o.r.

COMMAND TRANSMITTERS

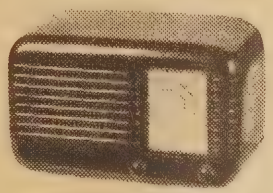
WITH VALVES AND CRYSTAL.

55/- F.O.R.

4 equals 5.5 Mcs., or 5.3 equals 7 Mcs.

New American Walkie-Talkie Chassis. With 4 piece telescopic AERIAL AND CIRCUIT. Contains basic parts for making small TRANSCEIVER. CHASSIS TYPE 536/511. 22/6. Post 2/6.

MAKE UP THE "LITTLE GENERAL"



£12/17/6

Complete kit of parts for the 1957 "Little General" as featured in R. and H., including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F Speaker and kit is complete to the last nut and bolt. (Set wired and tested, £2/15/- extra.)

Cabinet size 11½in long, 7in high, 6in deep. Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly 57/6

Post and Packing: N.S.W., 14/6:

Interstate, 25/-.

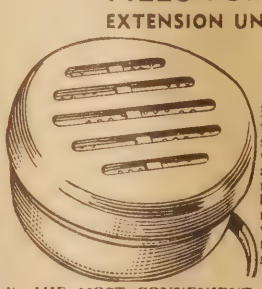
RADIO ALTIMETER APN.1

These units contain valves, midget genemotor (24v) and Wobulator unit used in the R. and H. sweep and marker generator. Also many other useful parts.

£4/17/-

F.O.R.

PILLO-FONE EXTENSION UNIT



IT'S A REAL MINIATURE WITH ROLA UNIT.

Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The 'PILLO-FONE' IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾in deep.

POST FREE. **22/6**

NEW DYNAMIC HEADPHONES

These headphones made by Rola are a high-quality unit giving excellent tone. Fitted with comfortable ear pads.

25/-

Post 4/6.

24 Volt Midget Motors Shunt Wound

Fully Laminated Fields. Wound Armature. Sixteen Segment Commutator, ball bearing. Ideal for Model Trains, Hobbyists, etc. Condition new.

Price, each, **25/-**

Packing and Postage: N.S.W., 1/6: Interstate, 2/6.

No. 22 TRANSCEIVERS

The 22 transceiver covers a frequency of 2 to 8 Mcs., and has been approved by the P.M.G. for use on fishing boats, small craft, bush fire brigades, etc., if converted to crystal control, for which it is easily adapted. These sets are supplied complete with valves, 12v. vibrator, power supply, dynamic headphones and microphone leads.

£12/17/6

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 Mcs., and contain 15 6.3 volt valves, including 1-807, 2-6V6, 6-6K7, 2-6K8, 6B8, etc., also 500 microammeter.

Units supplied complete with valves, leads, junction box, genemotor power supply and dynamic headphones and microphone operate from 12v. supply.

£7/15/-

F.O.R. PACKAGE 15/- EXTRA.

METROPOLITAN RADIO SUPPLIES

832 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7398

640 KING STREET, ST. PETERS, N.S.W. PHONE LA6087

HIGH LEVEL SPEECH CLIPPING

(Continued from Page 71)

C amplifier supply negative, followed by a low pass filter.

The system is not without its defects (High-Level Clipping and Filtering, QST Nov. 1951) but does permit a worthwhile increase in modulation. Assuming that the class-B amplifier has a reserve of output, the plate meter will kick up with modulation, indicating carrier shift.

A mercury vapour rectifier with the filament operated from an insulated winding would be suitable for use in the case of high power transmitters. For the mobile transmitter the OA31 germanium rectifier was perfectly suitable. It has a peak inverse rating of 85 volts at normal temperatures and a more than adequate forward current capacity.

FILTER TYPES

Low pass filters can be made in various combinations depending on the performance required. Really excellent performance can be obtained with a constant-k pie section terminated at either end by an m-derived section the m values being slightly staggered. However this normally involves three iron cored inductors.

Worthwhile results can be obtained with a single section filter. The m-derived section gives sharpest cut-off but does allow some of the higher frequencies to get through. A single pie section of the constant-k type is to be preferred because there is greater attenuation of the higher frequencies. In our case response is level to 2kc, 2db down at 3kc, 5db at 4kc and 10 db at 5kc.

The value of L may be calculated from:

$$L = \frac{R}{\pi f c} \text{ HENRIES}$$

where; R is the impedance of the modulated amplifier

fc is the cut-off frequency (nominally 3,000 cps).

Similarly the value of C is:

$$C = \frac{1.000.000}{2\pi f c R} \text{ MICROFARADS}$$

In this case, it turned out that the inductance value required was about .6H. A choke was made by winding 1,000 turns of 35 B and S wire on the core of a small speaker transformer. The assembled laminations were 1½in by 1½in by ½in thick. A cardboard bobbin (to fit over a ½ by ½ core) was made and the wire wound on with the aid of a hand drill. Layers of thin paper were used to insulate wire layers.

The inductance was checked with minimum air gap and found to be about 1.5H. However, it was reduced to the correct value by using four layers of writing paper to form a magnetic gap.

The final value of inductance n easily be checked with the choke place. Temporarily wire a resistor series with the choke. (1,000 ohms often suitable.) Adjust the plate curr of the class-C amplifier to its norr value then with a below-overload sig through the modulator, measure the voltage appearing across both the ch and the resistance.

The ratio of the voltage across choke to that across the resistor give the ratio of inductive reactance the value of the resistance. Inducta can then be calculated from

$$L = \frac{X_L}{2\pi f} \text{ HENRIES}$$

where: L is the inductance

Xl is the inductive reactance

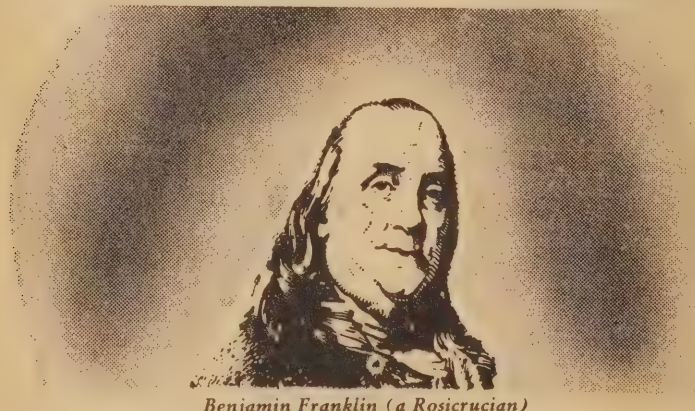
A good choice for F is 1,000 cp

Note that the voltage measured acr both components will not be the sa as the sum measured separately. W many multimeters, the AC reading be affected by the DC component the safest procedure is to place a ca citor in series with the instrument.

To make full use of the filter arran ment, higher gain in the audio chai required and in the mobile transmi made it desirable to use another st The overall gain required for the posals insert is now so high that rip on the heater line from the genem ignition system of the car is noticea

There is therefore a good argum for a more modern high-output dyna microphone.

WHAT SECRET POWER DID THIS MAN POSSESS?



Benjamin Franklin (a Rosicrucian)

Why was this man great? How does any one—man or woman—achieve greatness Is it not by mastery of the powers withi ourselves?

Know the mysterious world within you Attune yourself to the wisdom of the age Grasp the inner power of your mind Learn the secrets of a full and peaceful life! Benjamin Franklin—like many othe learned and great men and women—was Rosicrucian. The Rosicrucians (NOT religious organisation) first came t America in 1694. To-day, headquarters o the Rosicrucians send over seven millio pieces of mail annually to all parts of th world.

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The ROSICRUCIANS (AMORC)

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ANSWERS TO CORRESPONDENTS

B.Y. (Ascot Vale, Vic.) asks why, in a recent mple receiver, the HT CT of the transformer s earthed via two pins in the speaker plug d socket.

A. The idea is simply to break the HT cir- it if the receiver is inadvertently switched on th the speaker not plugged in. This could mage the output valve, because there would no voltage on the plate and full voltage on e screen. It may also cause failure of the er capacitors, due to reduced HT drain and cessive voltage. Rather than take these risks, e wiring is arranged so that the HT circuit not complete until the speaker plug is in- rted normally. The shorting link is, of course, the plug, not across the socket.

R.M. (Darlington, W.A.) has an AC/DC re- iver in which the ballast tube has "had it." e says that local radio dealers have been very gue about it, and asks us for specific informa- on.

A. Sorry R.M., but we cannot be specific either. efore we could suggest what substitute resistor as necessary, it would be necessary to know the ltage drop required and the current flowing in e ballast circuit. This would yield a figure r resistance and wattage. Physical size and ape might also be important. A knowledge of e valve line-up would indicate a possible ure for resistance and wattage, but would take account of any special circuit tricks which ight be involved. Your best plan would be turn it over to a local serviceman and let m do the worrying and the work. You will ve an uphill battle to solve it on your own

G.J. (Enfield Heights, S.A.) wonders if we have y plans to describe a transistorised tape re- rder.

A. No immediate plans, G.J., although we agree at such a project would have a wide appeal. itable motors, heads and other mechanical parts good supply would be the main prerequisite the description of such a unit in Radio, Tele- sion and Hobbies. Glad to note that the DX nior is working as it should. As you suggest it ould be a good idea to remove turns from e aerial coil if the selectivity is not good enough present. Some compromise will be necessary ecause the gain will be reduced quickly as the oupling is reduced below a certain value. You ill find also that below a certain critical value coupling the improvement in selectivity will small. This unfortunately is one of the mitations of a simple receiver.

R.R. (Riverwood, N.S.W.) forwards the cir- uits of a couple of small transistor receivers for clusion in the "Reader Built It" page.

A. Thank you for your interest, R.R., but we annot publish these circuits unless you have act- ally built them, and we have an assurance from ou that they operate as intended. We would ke to hear from you later when you have had n opportunity to test the completed set and com- ent on its performance, plus any modifications ou may find desirable. We agree that many eaders would like to see simple transistor re- eivers described. You will note that we have ade a start with such sets in current issues.

M.P. (Hurlstone Park, N.S.W.) wants to know hether any damage would result from fixing a ambler Portable more or less permanently in a ar. He also wants to know whether we can upply details of a vibrator supply to allow it to e run from the car battery.

A. The valves used in sets of this kind have elatively fragile filaments, and they could be amaged by continual vibration. It is difficult to ay how bad this would be in practice, but we ould hesitate to recommend it. There are also erious objections to operating the set from the ar battery, due to the variations in voltage hich occur in a car electrical system under nor- al operating conditions. These would be out- de the permissible tolerances for valves of this pe, and could lead to premature failure if the et-up was designed around the nominal voltage f the system, or unsatisfactory performance if it as designed to allow for the maximum voltage kely to be encountered during charging. In ie circumstances we feel it would be unwise to ursue this course. The current drawn by such set would be small compared with a con- entional car radio.

S.W. (Brisbane, Qld.) has just passed his limited mateur operator's certificate of proficiency exam- ation and is thinking about building equipment.

A. The 2JU 5-valve receiver from the March, 947, issue, is not very suitable for use on the HF bands, but you would find plenty of use r it in listening to other amateurs on the gh frequency bands. The performance is good rough to be very useful on the two lower fre- ency bands, but is naturally limited on the 14, , and 28 Mc/s bands. If the bandspread ar- ngements were altered to suit, the receiver ould give quite acceptable performance when ed in conjunction with a VHF converter. Units suitable for 144 Mc/s have been described in the May, 1948, and March, 1953, issues and a 50 Mc/s converter in the February, 1953, issue. The February, 1947, transmitter would not be suitable for 50 or 56 Mc/s operation, but a small transmitter which would be worth considering was described in the February, 1953, issue. A good deal of development in VHF transmitter design has taken place in the last few years, and we regret that we cannot suggest a circuit from our own files, which could be considered really up-to-date.

A.S. (Rasamia, N.Z.) is one of our younger readers who writes to make some suggestions and ask a few questions. In particular, he expresses regret that we have discontinued such articles as "The Junior Experimenter," etc., which he found in some back copies he acquired.

A. Many thanks for your letter and comments, A.S. While it is true that we no longer present some of these as regular features, we still devote a considerable proportion of our constructional articles to simple projects for beginners. In fact, we devote about as much space to articles of this kind as possible, consistent with the requirements of more advanced readers. We regret we have no general coil data of the type you require, this usually being specified with a particular piece of equipment and designed to take into account the type of tuning capacitor, the IF to be used, etc., which often vary considerably with different designs.

N.C. (Ermington, N.S.W.) sends along a circuit which he obtained from one of our advertisers.

A. The circuit is for an RF type EHT supply and could be used to operate a cathode ray tube either in a CRO or in a simple television receiver. We have already described such a supply and there would be no point in reprinting this particular circuit. Sorry, but we cannot help you in regard to the transformer you mention. Disposals gear was simply full of odd transformers, and it would be a task indeed to keep track of them all.

J.B. (Wollongong, N.S.W.) forwards a copy of a circuit which appeared in a radio publication dated 1931. The circuit is of a one valve plus crystal detector receiver. The signal from the aerial is fed to a tuned circuit and thence to a tetrode RF amplifier. There is another tuned circuit, a crystal detector, and finally a pair of headphones. J.B. would like to know if the set would be successful and if so what type of valve would be suitable.

A. The set would certainly work, and you would probably be able to receive a number of stations. However, it would be possible to build a set with as good or better performance by using the valve as a regenerative detector/audio amplifier combination. This would require fewer components. Any one of hundreds of different valve types would be suitable for your circuit. The modern ones would be pentodes, in which case you would simply connect the suppressor to the filament, if not already connected internally. The general description of the valve you require is an RF pentode. Details of filament, plate and screen voltage depend on the particular valve and you could obtain the information from a valve data book. If you would like to experiment with small receivers, we could do no better than commend to you the small transistor receivers which have been described in recent issues. Alternatively, we can supply the circuits of a number of excellent small receivers using valves through the 2/ query service.

G.N.R. (Toowoomba, Q'land) has forwarded a number of queries concerning records and recording speeds.

A. We feel that we could do more justice to your queries if we answer them in the "Answer Tom" feature, rather than on this page. Consequently we are holding your letter for inclusion at the earliest opportunity.

R.M. (Bundaberg, Q.) wishes to build the Basic Three described in the November issue, but wishes to use a permag speaker in place of the electrodynamic type originally suggested.

A. Such a speaker can be used, R.M., and there are at least two possible approaches. If you have any choice in the matter it would be best to select a power transformer with a 285 volt or even 225 volt secondary. In the latter case the 1,000-ohm resistor ahead of the first electrolytic would not be needed. In all cases, however, it would be necessary to replace the speaker field with a filter choke. One of the 12/50 types or similar would be suitable. If a 385 volt transformer must be used the filter choke would still be desirable but the 1,000-ohm resistor already mentioned would need to be increased until the toal HT voltage was reduced to approximately 250. A total value of between 2,000 and 3,000 ohms would be required, and would need to have at least a 10-watt rating. Note also that the first electrolytic would need to be rated at 600 PV.

T.B. (Stanley, Tasmania) wants to know if we have ever described any form of AC operated power pack to replace batteries in battery receivers.

A. One such power supply was described in the October, 1956, issue, and would at least serve as a basis for experiment. Copies of this issue are still available if required. This unit was designed to deliver 67.5 or 90 volts HT and 1.5 volts for the filaments. It might be possible to arrange a 6-volt supply, but it would be necessary to know the exact nature of the circuit, current drain, etc., before a definite answer could be given.

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To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cut-outs in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

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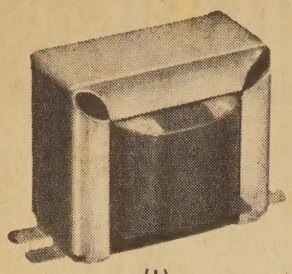

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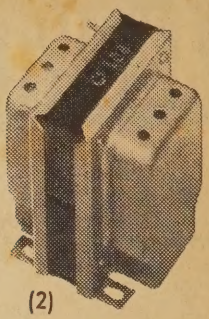

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OPM3	10	S.E. 4000, 2500	15, 12.5, 8, 3.7, 3.1, 2	2
OPM4	10	S.E. 4000, 2500	500, 250, 166, 125	2
OPM5	15	P.P. 5000, 3000	15, 12.5, 8, 3.7, 3.1, 2	2
OPM6	15	P.P. 5000, 3000	500, 250, 166, 125, 100	2
OPM7	15	P.P. 10000, 8000, 7000	15, 12.5, 8, 3.7, 3.1, 2	2
OPM8	15	P.P. 10000, 8000, 7000	500, 250, 166, 125, 100	2
OPM10	25	P.P. 8000, 6600	15, 12.5, 8, 3 7, 3.1, 2	2
OPM9	25	P.P. 8000, 6600	500, 250, 166, 125, 100	2
OPM14	35	P.P. 8000, 6600	15, 12.5, 8, 3.7, 3.1, 2	2
OPM11	35	P.P. 8000, 6600	500, 250, 166, 125, 100, 71	2
OPM13	55	P.P. 3500	15, 12.5, 8, 3.7, 3.1, 2	2
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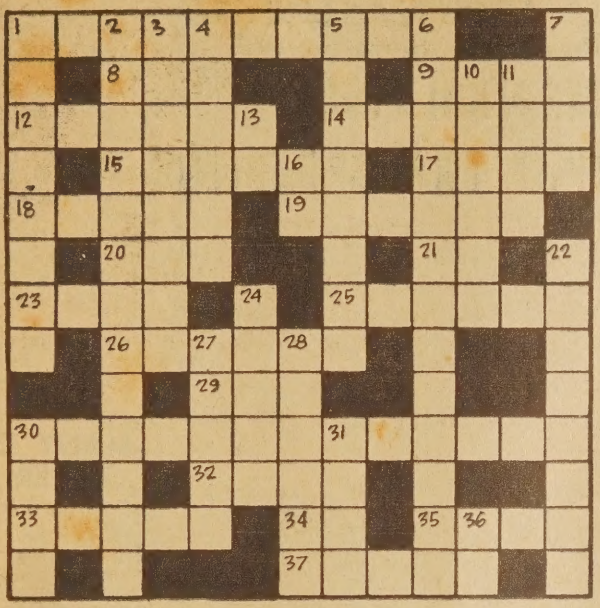

ACROSS

1. Resistor to prevent parasitic oscillation.
2. Metallic rock.
9. Sound reflection.
12. Consuming.
14. A resonant transmission line.
15. Lure.
17. Fatigue.
18. A social activity.
19. Busy.
20. To spread hay.
21. Symbol for iron.
23. Lament audibly.
25. Prayer.
26. Bivalve shell-fish.
27. Number.
29. Producing electrical impulses under mechanical stress.
32. Formal.
33. Printing machine.
34. Yes (Span).
35. S-shaped moulding.
37. River (Eng.).

DOWN

1. A transformer ratio.
2. Variable resistor.
3. August.
4. Leased.
5. A telephone switching device.
6. Conversion to DC.
7. Heart.
10. Salad vegetable.
11. In this place.
13. U.S. Soldier.
16. Chartered accountant (abbr.).
22. Grabs.
24. Guide.
27. Ceases.
28. Engage.
30. Smoking implement.
31. Arabian prince.
36. Suffix for valve type.

Solution and further crossword next month

Last month's solution

A	G	N	E	T	I	C	F	O	R	C	E			
	E		W	A	N	E		V	E		G			
E	C	H	E	R	W	I	R	E	S		A			
A	K	E	S		A	L	E	R	T	E	D			
R	O	N		G	R	I	T			V				
	R			D	N	I	E	P	E	R				
	E	Y	E	S		G	R	E	E	N				
I	N		M	Y			E	L	L		M			
		A	B	S	C	I	S	S	A		E			
M	U	L	E	T					G	A	S			
		I	R	E	N	E		L	I	E	N			
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ANSWERS TO CORRESPONDENTS

A.B.S. (Mosman, N.S.W.) has a number of old power transformers on hand which he cannot use because of lack of identification of the leads. He asks that we send a copy of the colour code employed for transformers. He is also interested in the C.R.O. described in the September 1947 issue.

A. There is no generally accepted code for transformer leads as far as we know A.B.S., particularly in regard to units made some years ago. The only satisfactory approach to this problem is to identify some of the filament windings, by reason of the heavy gauge wire employed, then energise this with an approximately similar value of AC voltage. Measurement of the voltages delivered by the other windings will usually enable them to be sorted out. The C.R.O. of September 1947, while useful in a limited way, was made with a rather specialised application in mind. We doubt if you would find it suitable for everyday work. We would refer you to the October 1957 issue (available if required) page 60 for a suggested simple circuit.

C.F. (Blacktown, N.S.W.) is intereseted in transistorised tape recorders and asks about battery life in the case of the "Transporta Six."

A. Thanks for the kind comment regarding the magazine. We agree that the "Hobbies" section has suffered in recent years in relation to the Radio, Television and Popular Science sections but this is simply a reflection of the needs of readers. We regret that we cannot be of assistance with regard to the recorder bias oscillator. The few firms who have done work along these lines have probably spent a good deal of money in obtaining the desired results and would not be anxious to pass the information on. All comments with regard to the transistor set noted and we are glad that you are so happy with the performance of the finished article. If used on an average of two hours per day we would expect the life of the battery to be at least six months but it could be up to 12 months. It depends on a number of factors including the volume at which the set is operated. Under the worst likely conditions, it is good value for money. Your present address has been noted.

D.S. (Indooroopilly, Q.) is puzzled by the term "decibel" and quotes a definition from an overseas magazine with a request that we enlarge upon it.

A. This is rather too involved a subject to deal with thoroughly in the query service D.S., but we may pass it on for possible use in Answer Tom at a later date. However, the definition is quite accurate, the decibel being used to compare one level of sound or signal strength with another. It is sometimes defined as a unit of loss or gain, since it is used to express the amount of improvement of degradation occurring in a particular circuit. The bel is merely the basic unit and the decibel a convenient division of it. The important feature of the decibel, is that it is based on a logarithmic scale, whereby each two to one increase in power is represented by the addition of 3 db. This is to allow the scale to express something of the effect experienced by the ear, which is not very sensitive to changes in level, a 3 db increase being only just noticeable.

R.S. (Pomona, Qld.) is troubled by static due to electrical storms during the wet seasons and he wonders if anything can be done to improve the situation.

A. If, as you say, reception is good when the storms are not present, modifications to the aerial will not bring about an improvement. However, it would be well worth trying a series diode noise limiter such as the one which appears on page 41 of the October 1958 issue. The signal-to-noise ratio of the system would be improved by the use of a highly selective IF amplifier but the addition of extra components to obtain the selectivity may be a major task. Under certain conditions, reception on the shortwave bands may be more favourable than on the broadcast band and this may be worth checking. The noise limiter would still be effective.

J.P. (Bellerive, Tas.) is anxious to see a design for an oscilloscope using a VCR139A CR tube described in the magazine.

A. Several simple instruments using this tube have already been described and circuit diagrams are available through the 2/- query service. A simple modulation checker appeared in the September 1947 issue while C.R.O.'s which were described in January 1948, March 1950 and April 1950 could use the VCR139A without circuit change. The socket connections are Pin 1: cathode, pin 2: grid, pin 3: heater, pin 4: heater, pin 5: P1, pin 6: no connection, pin 7: Y2, pin 8: X2, pin 9: P2, pin 10: X1, pin 11: Y1, pin 12: no connection. Note that the heater voltage is nominally 4 volts and that to operate the tube from a 6.3 volt supply a 2.1 ohm series resistor is necessary. We suggest that the circuit in the October 1957 issue may be of interest. Copies are available if required.

M.D.K. (Sydney, N.S.W.) lists a number of commercial TV sets and wants to know which we consider the best. He also enquires whether it is true that an indoor aerial will strain a set.

A. As you can readily appreciate M.D.K., it would be quite impossible for us to comment on the relative merits of the receivers you mention. However, we are quite sincere when we say that they are all reliable brands, and we doubt if you would be disappointed with any one of them. In answer to your second question, we would state most emphatically that the use of an indoor aerial is in no way harmful to the set. This point has been covered in the magazine on a number of occasions, mainly in the Serviceman articles. It is impossible to advise regarding the effect of a damaged component on a radio receiver, since it depends on the component concerned. However, it is quite possible for some comparatively common faults to cause a lot of damage to the set if it is not switched off. In some cases it could even start a serious fire.

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BENCH TYPE VACUUM-TUBE VOLTMETER

(Continued from Page 62)

across the bottom, about midway between front and rear.

Some "doctoring" of the case also will be necessary to allow easy fitting of the panel. The turned in edges on which the panel mounts will need to have some semi-circular openings filed in them to clear some of the components mounted near the edge of the panel. These include the zero pot, the edge of the function switch, the input terminals, and the probe socket.

This should cover all the major points necessary to enable the reader to complete the instrument at least to the point of calibration. Next month we will have more to say on this subject, as well as a discussion on suitable probes for use with it.

(TO BE CONTINUED)

Let's Buy An Argume

(Continued from Page 83)

a thing as Contra Terrene matter but I hadn't read about it.

I would be in much the same pre ment as is "Diallist," the well-k columnist in "Wireless World." I October issue last, he very seriously ed how a television camera could pos see anything on the dark side of moon, since there would not be en light to satisfy the requirements of the most sensitive known picture tub

I gather that he is still doing his to escape from under a pile of l which point out that the term "dar a purely figurative one, as it is in t like "the dark ages," "the dark co ent," etc.

It is dark to us, only in the sense we never see it. But it gets its quo sunshine and shadow like other cel bodies.

MANY USES FOR ZENER DIODES

(Continued from Page 53)

Limiter, Clipper. The circuit in figure 4(A) may be employed signal limiter when an AC sign applied to its input terminals. Wit diode connected as shown, the a will be positive peak-limiting. Whe diode is reversed, negative peak-lin will be obtained.

Similarly, the current given in 5(A) may be employed as a clippe limiting both positive and negative amplitudes.

The zener diode limiter and cl circuits have the advantage over si circuits employing conventional di that no bias batteries are req Either pulse or sinusoidal signals be limited or clipped with these circ

Editor's Note: The foregoing a should be valuable as an indicatio the principles and likely applicatio Zener diodes. However, the rang values and the specifications woul pear to relate more to what ca achieved than to units which are rently available on the market. S for example, list Zener diodes for ages between about 3 and 15 tolerances of 5, 10 and 20 per cent

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